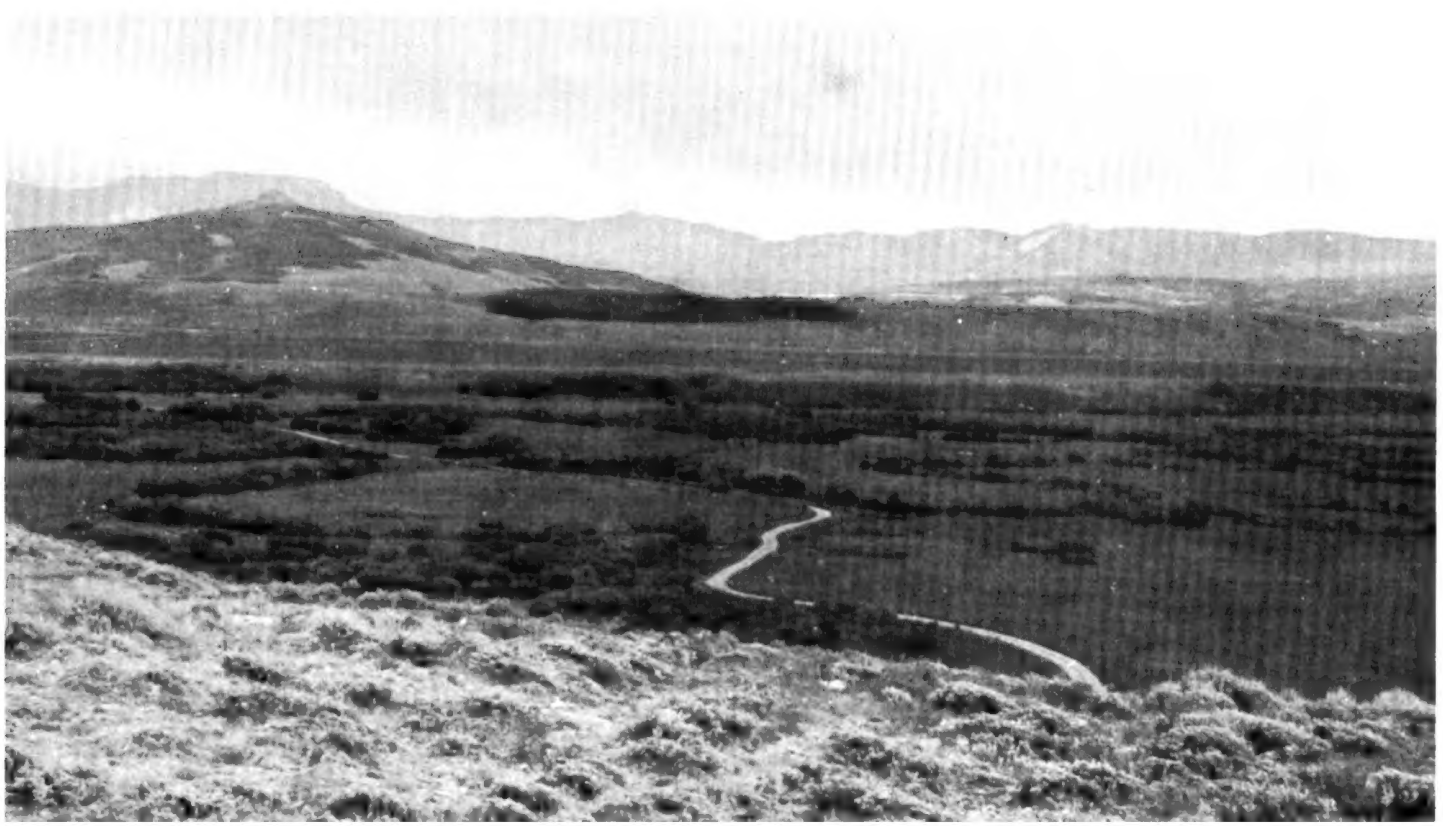
SOIL SURVEY OF

Jackson County Area, Colorado



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Colorado Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1957–73. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and Colorado Agricultural Experiment Station. Financial assistance was provided by the North Park Soil Conservation District. It is part of the technical assistance furnished to the North Park Soil Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing ranches; in selecting sites for roads, ponds, buildings and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All of the soils in the Jackson County Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise it is outside the area and a pointer shows where the symbol belongs.

Finding and Using Information

The "Index to Mapping Units" lists all of the soils of the area in alphabetic order by map symbol and shows the page where each soil is described. Other information can be obtained from the tables listed in the "Summary of Tables."

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green; those with a moderate limitation can be colored yellow; and those with a severe limitation can be colored red.

Ranchers and those who work with ranchers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the range sites, and the woodland groupings.

Foresters and others can refer to the section "Woodland," where the soils of the area are grouped according to their suitability for trees and shrubs.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings and recreation areas in the section "Engineering Interpretations of the Soils."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in the Jackson County Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the area given in the section "General Nature of the Area."

Cover: Jackson County Area consists of grass-sagebrush range, irrigated hay meadows, and forested mountains.

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Issued March 1981

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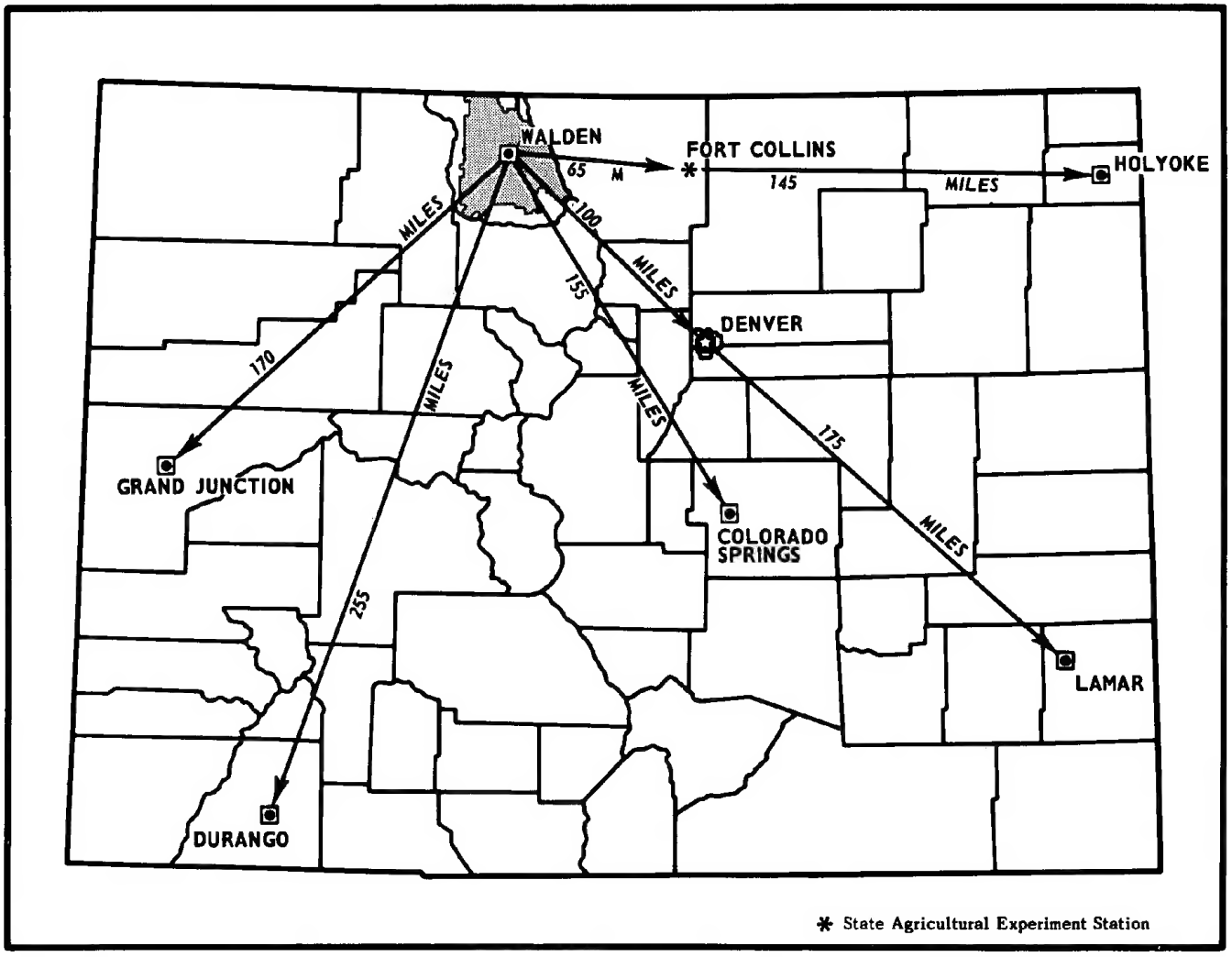

Location of Jackson County Area in Colorado

SOIL SURVEY OF JACKSON COUNTY AREA, COLORADO

BY LOUIS A. FLETCHER, SOIL CONSERVATION SERVICE[1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE COLORADO AGRICULTURAL EXPERIMENT STATION

JACKSON COUNTY AREA is in north-central Colorado, joining Wyoming on the north (see map on facing page). It is a large basin, called North Park, bounded by the Medicine Bow Range on the east and by the Park Range on the west. The Rabbit Ears Range separates North Park from Middle Park to the south. For the most part the boundary of the Area lies on the lower sides of the mountains, except at the eastern and southeastern edges, where the Area extends above timberline. The boundary of the survey area coincides with the boundary of the surrounding national forests. The survey area is about 712,640 acres, or 1,113.5 square miles, in size. The North Park basin is approximately 50 miles long and 20 miles wide. Walden, the county seat, is in the center of the survey area on the park floor.

Elevation of the park floor ranges from about 9,000 feet at Gould to slightly less than 8,000 feet at Northgate where the North Platte River breaks through into Wyoming. The mountain ranges are less than 13,000 feet in elevation and are abrupt. Clark Peak, elevation 12,965 feet, is the highest point in the Area. Timberline is generally less than 10 miles from the outer edge of North Park. North Park is the origin of the North Platte River.

Winter is long and cold, and summer is short and cool. The average annual temperature at Walden is 37.8° F. Temperatures of 50° below zero are common in winter, and in summer temperature seldom reaches 90°. Average annual precipitation ranges from 9.1 inches at Walden, in the center of the Area, to more than 40 inches at Cameron Pass, in the southeast corner of the Area. The average length of the growing season ranges from less than 10 days above timberline to about 45 days at Walden.

Jackson County Area is mainly agricultural. About 20 percent of the Area is irrigated and used for grass hay and pasture. The rest is in range and forest. Raising cattle is the main livestock enterprise.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in Jackson County Area, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have a profile almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Cowdrey and MacFarlane, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Cowdrey loam, 4 to 10 percent slopes, is one of several phases in the Cowdrey series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different

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series or of different phases within one series. Two such kinds of mapping unit—soil complexes and soil associations—are shown on the soil map of Jackson County Area.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Coalmont-Fluetsch complex is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but that are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Boettcher-Bundyman association is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called miscellaneous land types and are given descriptive names. Dune land is an example.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them ranchers, managers of woodland and range, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General soil map

The general soil map at the back of this survey shows, in color, the soil associations in the Jackson County Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in other associations, but in different patterns.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a ranch or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey have been grouped into four general kinds of landscape for broad interpretative purposes. Each of the broad groups and the soil associations in them are described in the following pages.

Soils on low terraces, on flood plains, in upland depressions, and on irrigated benches

The associations in this group are made up of deep, poorly drained to well drained sandy loams, loams, and clay loams. The soils formed in alluvium and outwash. Slopes are 0 to 5 percent.

1. Randman-Blackwell-Dobrow association

Deep, poorly drained, dominantly sandy loams and loams that formed in alluvium and outwash; in some, very gravelly sand is at a depth of less than 40 inches; on low terraces, flood plains, and benches; slopes of 0 to 5 percent

This association is along the North Platte River and its tributaries and on irrigated benches and terraces throughout the Area. It makes up about 22 percent of the Area. It is about 28 percent Randman soils, 19 percent Blackwell soils, and 18 percent Dobrow soils. The remaining 35 percent is Fleer, Eachuston, Wichup, and Walden soils and Cryaquents.

Randman soils are on low terraces and benches. They are deep and have very gravelly sand at a depth of less than 40 inches. Slopes are 1 to 4 percent. Typically, the surface layer is grayish brown sandy loam about 6 inches thick. The subsoil is grayish brown and light brownish gray gravelly sandy loam and gravelly sandy clay loam about 24 inches thick. Very gravelly sand is at a depth of 30 inches.

Blackwell soils are on flood plains and low terraces. They are deep. Slopes are 0 to 5 percent. Typically, the surface layer is very dark grayish brown loam about 13 inches thick. The subsoil is light brownish gray sandy clay loam and gravelly loam about 33 inches thick. Sand and gravel are at a depth of about 46 inches.

Dobrow soils are on flood plains. They are deep and have very gravelly sand at a depth of less than 40 inches. Slopes are 0 to 2 percent. Typically, the surface layer is dark grayish brown loam about 4 inches thick. The underlying material is dark gray and gray sandy

loam about 24 inches thick. Very gravelly sand is at a depth of about 28 inches.

All of this association is irrigated and used for grass hay and pasture.

2. *Spicerton-Stumpp association*

Deep, well drained to somewhat poorly drained sandy loams and clay loams that formed in alluvium; on flood plains, on low terraces, and in upland depressions; contain excess salts that affect plant growth; slopes of 0 to 5 percent

This association is in the west-central part of the Area. It makes up about 4 percent of the Area. It is about 75 percent Spicerton soils and 10 percent Stumpp soils. The remaining 15 percent is Boettcher, Bundyman, and Girardot soils.

Spicerton soils are on low terraces and in depressions on uplands. They are deep. Slopes are 0 to 5 percent. Typically, the surface layer is pale brown sandy loam about 2 inches thick. The subsoil is brown clay about 10 inches thick. The underlying material is brown clay. Salts have accumulated in the lower part of the subsoil and in the underlying material; these salts affect plant growth.

Stumpp soils are on flood plains and low terraces and in depressions on uplands. They are deep. Slopes are 1 to 3 percent. Typically, the surface layer is very dark gray clay loam about 3 inches thick. The subsoil is very dark gray clay about 23 inches thick. The underlying material is gray clay. Very gravelly loamy sand is at a depth of about 32 inches. Salts have accumulated in the subsoil and underlying material above the gravelly loamy sand; these salts affect plant growth.

Most of this association is used for grazing. Some of it is irrigated and used for grass hay and pasture.

Soils on benches and uplands

The associations in this group are made up of shallow to deep, well drained and moderately well drained sandy loams, loams, and clays. The soils formed in alluvium, outwash, and materials weathered mainly from sandstone or shale. Slopes are 2 to 30 percent.

3. *Fluetsch-Bosler-Tealson association*

Deep and shallow, well drained sandy loams that formed in old alluvium, glacial outwash, and material weathered from sandstone; mainly on uplands, high terraces, and benches; slopes of 2 to 30 percent

This association is in the center of the Area. It makes up about 12 percent of the Area. It is about 32 percent Fluetsch soils, 22 percent Bosler soils, and 18 percent Tealson soils. The remaining 28 percent is Tiagos and Forelle soils, Cryorthents, and Rock land.

Fluetsch soils are on rolling high terraces, old alluvial fans, and sides of valleys. They are deep. Slopes are 2 to 15 percent. Typically, the surface layer is pale brown and brown sandy loam about 10 inches thick. The subsoil is light olive brown sandy clay loam 20 inches thick. The underlying material is yellowish brown sandy loam.

Bosler soils are on high terraces and benches. They are deep. Slopes are 2 to 5 percent. Typically, the surface layer is brown sandy loam about 3 inches thick. The subsoil is brown sandy clay loam about 12 inches thick. The underlying material is light olive brown sandy loam 6 inches thick in which lime has accumulated. Very gravelly coarse sandy loam is at a depth of about 21 inches.

Tealson soils are on low hills on uplands and on ridges. They are shallow. Slopes are 2 to 30 percent. Typically, the surface layer is brown sandy loam about 10 inches thick. The underlying material is olive channery sandy loam about 6 inches thick. Soft sandstone is at a depth of about 16 inches.

Most of this association is used for grazing. Some of it is irrigated and used for grass hay and pasture.

4. *Tiagos-Cabin association*

Deep, well drained fine sandy loams and sandy loams that formed in alluvium; in some, very gravelly sand is at a depth of less than 40 inches; on high terraces, benches, outwash terraces, alluvial fans, and uplands; slopes of 2 to 20 percent

This association is approximately at the outer edge of the floor of North Park. It makes up about 15 percent of the Area. It is about 45 percent Tiagos soils and 25 percent Cabin soils. The remaining 30 percent is Blevinton, Fluetsch, Forelle, and Coalmont soils and Cryorthents.

Tiagos soils are on rolling and hilly uplands, outwash terraces, alluvial fans, and till plains. They are deep. Slopes are 2 to 20 percent. Typically, these soils are grayish brown to pale brown fine sandy loam to a depth of 60 inches or more.

Cabin soils are on high terraces and benches. They are deep and have very gravelly sand at a depth of less than 40 inches. Typically, the surface layer is dark grayish brown sandy loam about 4 inches thick. The subsoil is brown gravelly sandy clay loam about 13 inches thick. The underlying material is pale brown very gravelly sandy loam about 9 inches thick. Very gravelly sand is at a depth of about 26 inches.

Most of this association is used for grazing. Some of it is irrigated and used for grass hay and pasture.

5. *Coalmont-Brinkert-Aaberg association*

Moderately deep over soft shale and deep, well drained and moderately well drained loams and clays that formed in old alluvium and material weathered from shale; on uplands and high alluvial fans; slopes of 3 to 15 percent

This association is in the central and eastern parts of the Area. It makes up about 2 percent of the Area. It is about 57 percent Coalmont soils, 16 percent Brinkert soils, and 12 percent Aaberg soils. The remaining 15 percent is Crespin, Fluetsch, and Morset soils.

Coalmont soils are on rolling hills and ridges on uplands. They are moderately deep. Slopes are 5 to 12 percent. Typically, the surface layer is light brownish gray loam about 4 inches thick. The subsoil is grayish brown and light brownish gray clay about 16 inches thick. The underlying material is light yellowish brown clay loam. Calcareous clay shale is at a depth of about 30 inches.

Brinkert soils are on rolling old high alluvial fans and high terraces. They are deep. Slopes are 5 to 12 percent. Typically, the surface layer is grayish brown loam about 5 inches thick. The subsoil is brown light to heavy clay loam about 15 inches thick. The underlying material is brown sandy clay loam.

Aaberg soils are on hills and ridges on uplands. They are moderately deep. Slopes are 3 to 15 percent. Typically, the soil is grayish brown and light olive brown clay throughout. Clay shale is at a depth of about 30 inches.

Most of this association is used for grazing. Some of it is irrigated and used for grass hay and pasture.

Soils on high terraces, mountain foot slopes, and sandy uplands

The associations in this group are made up of deep to shallow, well drained and somewhat excessively drained fine sands, sandy loams, gravelly sandy loams, loams, and clays. The soils formed in outwash, alluvium, and materials weathered from bedrock. Slopes are 0 to 25 percent.

6. Gelkie-Blevinton-Leavitt association

Deep, well drained, dominantly sandy loams and loams that formed in eolian sand, old alluvium, and glacial outwash; on valley sides, high terraces, benches, outwash plains, and alluvial fans; slopes of 2 to 20 percent

This association is at the outer edge of the floor of North Park. It makes up about 9 percent of the Area. It is about 30 percent Gelkie soils, 25 percent Blevinton soils, and 20 percent Leavitt soils. The remaining 25 percent is Gothic, Mord, and Buffmeyer soils and Cryorthents.

Gelkie soils are on high terraces and benches and on outwash plains. They are deep. Slopes are 2 to 15 percent. Typically, the surface layer is dark grayish brown sandy loam about 5 inches thick. The subsoil is brown and yellowish brown sandy clay loam about 27 inches thick. The underlying material is yellowish brown and light yellowish brown light sandy clay loam and heavy sandy loam.

Blevinton soils are on sides of valleys and on short terrace breaks. They are deep. Slopes are 8 to 20 percent. Typically, the surface layer is dark grayish brown and brown sandy loam and fine sandy loam about 30 inches thick. The subsoil is brown fine sandy loam about 18 inches thick. The underlying material is brown fine sandy loam.

Leavitt soils are on alluvial fans and sides of valleys. They are deep. Slopes are 2 to 5 percent. Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is dark brown, brown, and light yellowish brown loam and light clay loam about 28 inches thick. The underlying material is light yellowish brown loam. Lime has accumulated below a depth of about 28 inches.

Most of this association is used for grazing. Some of it is irrigated and used for grass hay and pasture.

7. Bangston-Tine association

Deep, well drained and somewhat excessively drained fine sands and sandy loams that formed in alluvium and eolian sand; on upland terraces and outwash plains; slopes of 1 to 10 percent

This association is east of the Canadian River in the northeastern part of the Area. It makes up about 4 percent of the Area. It is about 62 percent Bangston soils and 23 percent Tine soils. The remaining 15 percent is Grafen and Buffmeyer soils.

Bangston soils are on ridges and hills on uplands. These well drained and somewhat excessively drained soils are deep. Slopes are 1 to 10 percent. Typically, the surface layer is dark grayish brown fine sand about 26 inches thick. The underlying material is pale brown and very pale brown loamy sand and sand.

Tine soils are on terraces and outwash plains. These well drained soils are deep. Slopes are 2 to 5 percent. Typically, the surface layer is brown sandy loam about 12 inches thick. The underlying material is brown loamy fine sand about 6 inches thick. Gravelly loamy sand is at a depth of about 18 inches.

Most of this association is used for grazing. Some of it is irrigated and used for grass hay and pasture.

8. Crespin-Sudduth-Gothic association

Deep, well drained, dominantly loams and clays that formed in glacial till, alluvium, and material weathered from shale; on uplands, mountainsides, valley sides, and fans; slopes of 0 to 20 percent

This association is at the outer edge of the floor of North Park and on the lower mountainsides. It makes up about 8 percent of the Area. It is about 30 percent Crespin soils, 25 percent Sudduth soils, and 10 percent Gothic soils. The remaining 35 percent is Carlstrom, Leavitt, Rogert, Parkview, and Lymanson soils.

Crespin soils are on alluvial fans and sides of valleys on low uplands. They are deep. Slopes are 5 to 15 percent. Typically, these soils are brown clay to a depth of 60 inches.

Sudduth soils are on alluvial fans and mountainsides. They are deep. Slopes are 5 to 15 percent. Typically, the surface layer is dark grayish brown loam about 4 inches thick. The upper part of the subsoil is dark grayish brown light clay loam about 3 inches thick, and the lower part is grayish brown clay loam about 13 inches thick. There is a buried subsoil of grayish brown, light brownish gray, and light olive brown clay about 14 inches thick. The underlying material is light olive brown clay that extends to a depth of 60 inches or more.

Gothic soils are on alluvial fans and sides of valleys. They are deep. Slopes are 0 to 20 percent. Typically, the upper part of the surface layer is dark grayish brown loam about 4 inches thick, and the lower part is grayish brown light clay loam about 8 inches thick. The subsoil is clay loam about 33 inches thick; it is yellowish brown in the upper part and mixed dark gray, olive, and light olive brown in the lower part. The underlying material is pale olive heavy clay loam.

Most of this association is used for grazing. Some of it is irrigated and used for grass hay and pasture.

9. Owen Creek-Rogert-Ethelman association

Moderately deep and shallow, well drained sandy loams and gravelly sandy loams that formed in material

weathered from sandstone and granite; on mountainsides and uplands; slopes of 0 to 25 percent

This association is in the northern part of the Area east of Independence Mountain. It makes up about 2 percent of this Area. It is about 35 percent Owen Creek soils, 30 percent Rogert soils, and 10 percent Ethelman soils. The remaining 25 percent is Bowen, Norriston, and Cabin soils.

Owen Creek soils are on uplands and mountainsides. They are moderately deep over soft sandstone of the North Park Formation. Slopes are 0 to 12 percent. Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The upper 4 inches of the subsoil is brown sandy clay loam, the middle 8 inches is dark brown heavy clay loam, and the lower 5 inches is brown and very pale brown clay loam in which lime has accumulated. The underlying material is very pale brown loam in which lime has accumulated. Soft sandstone is at a depth of 36 inches.

Rogert soils are on mountainsides. They are shallow over hard bedrock. Slopes are 10 to 25 percent. Typically, the surface layer is dark gray gravelly sandy loam and dark brown very gravelly sandy loam about 14 inches thick. Hard granite is at a depth of about 14 inches.

Ethelman soils are on rolling highlands. They are moderately deep over soft sandstone and siltstone. Slopes are 0 to 25 percent. Typically, the surface layer is dark grayish brown and grayish brown sandy loam about 7 inches thick. The subsoil is brown and pale brown fine sandy loam about 13 inches thick. The underlying material is light gray fine sandy loam; lime has accumulated in the lower part. Soft calcareous sandstone is at a depth of about 29 inches.

Most of this association is used for grazing. Some areas of the Owen Creek and Ethelman soils are used for nonirrigated crops and seeded pasture.

Soils on mountains

The associations in this group are made up of deep and moderately deep, well drained sandy loams and loams and Rock outcrop. The soils formed in glacial till, old alluvium, and materials weathered from bedrock. Slopes are 0 to 60 percent.

10. Pinkham-MacFarlane-Rock outcrop association

Deep, well drained, dominantly very stony and stony sandy loams that formed in glacial till, and Rock outcrop; on moraines on mountainsides; slopes of 10 to 60 percent

This association is at the extreme edge of the Area on both the east and the west sides. This association makes up about 8 percent of the Area. It is about 33 percent Pinkham soils, 24 percent MacFarlane soils, and 18 percent Rock outcrop. The remaining 25 percent is Mord, Larand, Yochum, and Troutville soils.

Pinkham soils are on mountainsides. They are deep. Slopes are 10 to 60 percent. Typically, the surface layer is light brownish gray stony sandy loam about 4 inches thick. The subsoil is brown very stony sandy loam about 10 inches thick. The underlying material is brown extremely stony sandy loam.

MacFarlane soils are on moraines on mountainsides. They are deep. Slopes are 25 to 60 percent. Typically, the surface layer is dark grayish brown extremely stony loam about 2 inches thick. The subsurface layer is very pale brown very stony sandy loam about 16 inches thick. The subsoil is yellowish brown extremely stony sandy loam about 22 inches thick. The underlying material is pale brown extremely stony sandy loam.

Rock outcrop is exposed hard bedrock in the form of sheer bluffs, crags, talus slopes, and areas where the bedrock blends with the surrounding landscape. Most of the rock is crystalline and acid igneous.

This association is in forest and is used for timber production, recreation, and wildlife habitat.

11. Nokhu-Lulude-Perceton association

Deep and moderately deep, well drained loams, cobbly loams, and sandy loams that formed in outwash, alluvium, and material weathered from sandstone and basalt; mainly on glacial terraces and mountainsides; slopes of 0 to 50 percent

This association is in the southeastern part of the Area. It makes up about 4 percent of the Area. It is about 58 percent Nokhu soils, 17 percent Lulude soils, and 10 percent Perceton soils. The remaining 15 percent is Cowdrey, Hyannis, and Larand soils and Rock outcrop.

Nokhu soils are on mountainsides and glacial terraces. They are deep. Slopes are 0 to 50 percent. Typically, the surface layer is dark gray loam about 1 inch thick. The subsurface layer is light brownish gray loam about 13 inches thick. The subsoil is brown clay loam about 22 inches thick. The underlying material is brown and pale brown light clay loam in which lime has accumulated.

Lulude soils are on mountainsides. They are moderately deep over basalt. Slopes are 10 to 25 percent. Typically, the surface layer is brown cobbly loam about 3 inches thick. The subsurface layer is pale brown cobbly loam about 19 inches thick. The subsoil is brown cobbly clay loam about 8 inches thick. Hard basalt is at a depth of 30 inches.

Perceton soils are on mountainsides and hills on uplands. They are moderately deep over soft sandstone. Slopes are 5 to 25 percent. Typically, the surface layer is very pale brown sandy loam about 20 inches thick. The upper part of the subsoil is yellowish brown sandy clay loam about 10 inches thick, and the lower part is pale brown sandy loam about 4 inches thick. Soft noncalcareous sandstone is at a depth of about 34 inches.

This association is in forest and is used for timber production, limited grazing, recreation, and wildlife habitat.

12. Peeler-Cowdrey-Perceton association

Deep and moderately deep, well drained, dominantly loams and sandy loams that formed in glacial till, old alluvium, and material weathered from sandstone; mainly on mountainsides; slopes of 4 to 50 percent

This association is in the southern and southwestern parts of the Area. It makes up about 4 percent of the Area. It is about 39 percent Peeler soils, 32 percent Cowdrey soils, and 19 percent Perceton soils. The re-

maining 10 percent is Hyannis, Sudduth, Troutville, and Larand soils and Rock outcrop.

Peeler soils are on mountainsides. They are deep. Slopes are 5 to 40 percent. Typically, the surface layer is very dark grayish brown sandy loam about 1 inch thick. The subsurface layer is pale brown sandy loam about 10 inches thick. The upper part of the subsoil is brown gravelly sandy clay loam about 9 inches thick, and the lower part is brown gravelly coarse sandy loam about 4 inches thick. The underlying material is light yellowish brown coarse sandy loam.

Cowdrey soils are on mountainsides. They are deep. Slopes are 4 to 50 percent. Typically, the surface layer is very dark gray loam about 3 inches thick. This subsurface layer is light gray light clay loam about 5 inches thick. The upper part of the subsoil is brown light clay about 12 inches thick, and the lower part is light olive brown gravelly clay about 6 inches thick. The underlying material is light olive gray clay.

Perceton soils are on mountainsides and hills on uplands. They are moderately deep over soft sandstone. Slopes are 5 to 25 percent. Typically, the surface layer is very pale brown and yellowish brown sandy loam about 20 inches thick. The upper part of the subsoil is yellowish brown sandy clay loam about 10 inches thick, and lower part is pale brown sandy loam about 4 inches thick. Soft, noncalcareous sandstone is at a depth of about 34 inches.

Most of this association is in forest and is used for timber production, grazing, recreation, and wildlife habitat.

13. Grimstone-Agneston-Bowen association

Moderately deep, well drained, dominantly gravelly sandy loams and sandy loams that formed in material weathered from mica schist, granite, and gneiss; mainly on mountainsides; slopes of 5 to 45 percent

This association is in the northwestern part of the Area, mainly on Independence Mountain. This association makes up about 5 percent of the Area. It is about 25 percent Grimstone soils, 20 percent Agneston soils, and 15 percent Bowen soils. The remaining 40 percent is Siebert, Peeler, Rogert, and Manburn soils.

Grimstone soils are on mountainsides. They are moderately deep over mica schist. Slopes are 5 to 25 percent. Typically, the surface layer is grayish brown sandy loam about 2 inches thick. The subsurface layer is light brownish gray and yellowish brown sandy loam and loam about 18 inches thick. The subsoil is yellowish brown clay loam about 7 inches thick. Weathered micaceous schist is at a depth of about 27 inches. A large amount of mica flecks are throughout the profile.

Agneston soils are on mountainsides. They are moderately deep over hard granite bedrock. Slopes are 5 to 40 percent. Typically, the surface layer is light brownish gray gravelly coarse sandy loam about 6 inches thick. The upper part of the subsoil is yellowish brown gravelly coarse sandy clay loam about 14 inches thick, and the lower part is brown very gravelly coarse sandy loam. Hard granite bedrock is at a depth of about 25 inches.

Bowen soils are on mountainsides and ridges. They are moderately deep over hard schist or gneiss. Slopes are 15 to 45 percent. Typically, the surface layer is dark grayish brown gravelly sandy loam about 7 inches thick. The upper part of the subsoil is brown gravelly heavy sandy loam about 3 inches thick, the middle part is yellowish brown very gravelly sandy clay loam about 8 inches thick, and the lower part is yellowish brown very gravelly heavy sandy loam about 4 inches thick. The underlying material is pale brown very gravelly sandy loam. Hard bedrock is at a depth of about 28 inches.

Most of this association is forested and used for timber production, recreation, and wildlife habitat.

14. Rock outcrop-Mirror association

Rock outcrop, and moderately deep, well drained gravelly sandy loams that formed in material weathered from gneiss and schist; on mountainsides above timberline; slopes of 10 to 40 percent

This association is at the extreme southeastern edge of the Area on mountainsides above the timberline (fig. 1). The soils in this association are very cold and remain frozen at some depth except for a short period during the short growing season. This association makes up about 1 percent of the Area. It is 50 percent Rock outcrop and 30 percent Mirror soils. The remaining 20 percent is soils that are similar to Mirror soils but that are not stony, are deeper to bedrock, and are somewhat poorly drained and poorly drained; these soils are along drainageways.

Rock outcrop is exposed hard bedrock in the form of bluffs, crags, talus slopes, and areas.

Mirror soils are on mountainsides above timberline. They are moderately deep over bedrock. Slopes are 10 to 40 percent. Typically, the surface layer is grayish brown gravelly sandy loam about 7 inches thick. The subsoil is light brown extremely stony sandy loam about 16 inches thick. The underlying material is yellowish brown extremely stony sandy loam. Hard bedrock is at a depth of about 32 inches.

This association is used for summer grazing, recreation, and wildlife habitat.

Descriptions of the soils

This section describes the soil series and mapping units in the Jackson County Area. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for dry soil unless otherwise stated. The profile described in the series is representative for

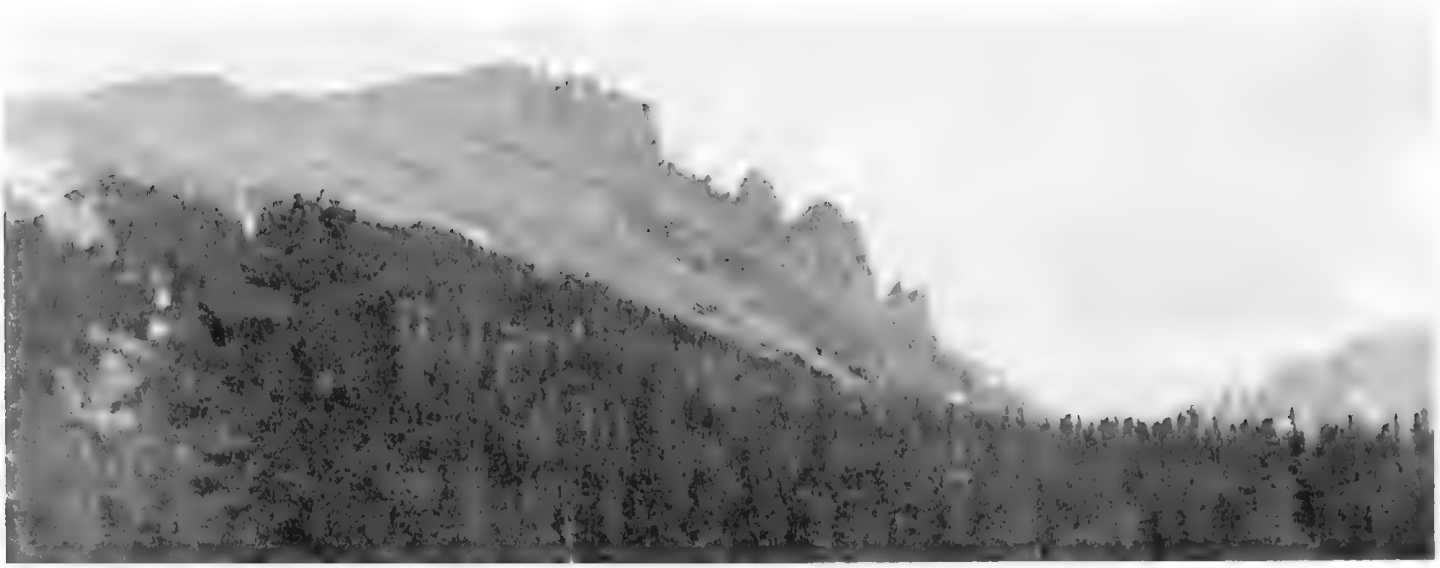

Figure 1.—**Mirror-Rock outcrop complex (in association 14) is above timberline. Spruce-fir are on Pinkham soils (association 10).**

mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Cryaquents, for example, do not belong to a soil series, but nevertheless, are listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is the symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit (irrigated, nonirrigated, or both) and range site in which the mapping unit has been placed.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*7*).[2]

Aaberg series

The Aaberg series consists of moderately deep, moderately well drained soils that formed in material weathered from Coalmont Shale. The soils are underlain by soft, slightly calcareous shale at a depth of 20 to 40 inches. They are on hills and ridges on uplands between elevations of 8,200 to 8,600 feet. Slopes are 3 to 15 percent. The native vegetation is mainly muttongrass, bluebunch wheatgrass, pine needlegrass, alkali sagebrush, and low rabbitbrush. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is grayish brown clay about 4 inches thick. The subsoil is light olive brown clay about 26 inches thick. Calcareous clay shale is below a depth of 30 inches.

Permeability is slow, and available water capacity is low. Aaberg soils have a high shrink-swell potential. They crack widely as they dry.

These soils are used mainly for grazing.

Representative profile of Aaberg clay in an area of Aaberg-Barishman association, in native grass, one-fourth mile east and one-eighth mile north of south quarter-corner of sec. 35, T. 9 N., R. 78 W.:

A1—0 to 4 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; strong fine granular structure; soft, friable, sticky and plastic; many fine and medium roots; mildly alkaline; clear smooth boundary.

B2—4 to 23 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; weak medium prismatic structure parting to moderate medium angular blocky; extremely hard, friable, sticky and plastic; few fine roots; a few thin glossy patches on peds; few slickensides; cracks 1 centimeter to 2 centimeters wide when dry; mildly alkaline; gradual wavy boundary.

B3—23 to 30 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; weak coarse angular blocky structure; extremely hard, friable, sticky and plastic; few slickensides; cracks 1 centimeter to 2 centimeters wide when dry; calcareous; moderately alkaline; gradual wavy boundary.

Cr—30 to 60 inches; slightly calcareous clay shale.

The B horizon is clay or heavy clay loam. The B2 horizon ranges from neutral to moderately alkaline in reaction.

Ab—Aaberg-Barishman association. This association is on hills and ridges on uplands. Slopes are 3 to 15 percent. This association is about 70 percent Aaberg clay and about 30 percent Barishman loam. The Aaberg soil is in slightly lower areas, and the Barishman soil is on small ridges less than 1 foot higher than the Aaberg soil.

Included with this association in mapping on slightly higher ridges are a few areas of Tiagos fine sandy loam less than 10 acres in size.

[2] Italic numbers in parentheses refer to Literature Cited, p. 156.

TABLE 1.—*Acreage and proportionate extent of the soils*

Map symbol	Soil name	Acres	Percent	Map symbol	Soil name	Acres	Percent
Ab	Aaberg-Barishman association	4,981	0.7	Le	Leavitt loam	9,482	1.3
Ag	Agneston gravelly coarse sandy loam, 5 to 40 percent slopes	5,084	0.7	LuE	Lulude cobbly loam, 10 to 25 percent slopes	4,741	0.7
Ba	Badland	1,340	0.2	LyD	Lymanson cobbly loam, 4 to 10 percent slopes	1,992	0.3
Bg	Bangston fine sand, 1 to 10 percent slopes	17,658	2.5	Ma	MacFarlane-Rock outcrop association	12,608	1.8
Bk	Blackwell loam	12,505	1.8	MbF	Manburn gravelly coarse sandy loam, 10 to 40 percent slopes	1,992	0.3
Bn	Blevinton sandy loam, 8 to 20 percent slopes	10,821	1.5	Me	Mendenhall loam	8,348	1.2
Bo	Boettcher-Bundyman association	5,703	0.8	Mn	Mine pits and dumps	800	0.1
Bs	Bosler sandy loam	22,880	3.2	Mo	Mirror-Rock outcrop complex	7,386	1.0
Bw	Bowen gravelly sandy loam, 15 to 45 percent slopes	3,985	0.6	MrD	Mord loam, 4 to 15 percent slopes	5,394	0.8
Bx	Brinkert-Morset association	3,848	0.5	MsD	Morset loam, 1 to 15 percent slopes	7,489	1.1
By	Buffmeyer sandy loam, 4 to 18 percent slopes	2,577	0.4	MuE	Muggins loam, 5 to 30 percent slopes	859	0.1
Ca	Cabin sandy loam	23,326	3.3	NoE	Nokhu loam, 0 to 25 percent slopes	14,425	2.0
Cd	Chedsey loam, 5 to 12 percent slopes	2,817	0.4	NoF	Nokhu loam, 25 to 50 percent slopes	2,061	0.3
Cf	Coalmont-Fluetsch complex	16,661	2.3	Nr	Norriston gravelly sandy loam	1,615	0.2
CoD	Cowdrey loam, 4 to 10 percent slopes	10,924	1.5	Oc	Owen Creek sandy loam	4,947	0.7
CoF	Cowdrey loam, 10 to 50 percent slopes	6,012	0.8	On	Owen Creek-Norriston association	4,500	0.6
Cr	Crespin-Carlstrom clays	8,348	1.1	PaF	Parkview very stony loam, 20 to 35 percent slopes	5,565	0.8
Cs	Crespin-Carlstrom stony clays	1,889	0.3	PeE	Peeler sandy loam, 5 to 25 percent slopes	2,473	0.3
Ct	Cryaquents	23,567	3.3	PeF	Peeler sandy loam, 25 to 40 percent slopes	14,016	2.0
CyF	Cryorthents, steep	39,198	5.5	Ph	Perceton-Hyannis association	13,501	1.9
Do	Dobrow loam	9,585	1.3	Pr	Pinkham-Rock outcrop association	18,895	2.7
Du	Dune land	1,202	0.2	Ra	Randman sandy loam	18,654	2.6
Ea	Eachuston gravelly loam	4,775	0.7	RhD	Rawah loam, 3 to 10 percent slopes	3,092	0.4
EhE	Ethelman sandy loam, 0 to 25 percent slopes	1,340	0.2	Rk	Rock land	5,806	0.8
Fe	Fleer loam	3,608	0.5	Ro	Rock outcrop	8,211	1.2
Fh	Fluetsch-Tiagos association	94,226	13.2	RtE	Rogert gravelly sandy loam, 10 to 25 percent slopes	8,417	1.2
Fo	Forelle loam	11,234	1.6	Sp	Spicerton sandy loam	26,040	3.7
GeD	Gelkie sandy loam, 2 to 15 percent slopes	14,360	2.0	St	Stumpp clay loam	3,092	0.4
GkE	Gelkie sandy loam, moderately deep variant, 0 to 25 percent slopes	962	0.1	SuE	Sudduth loam, 5 to 15 percent slopes	12,711	1.8
Gn	Girardot silty clay loam	7,661	1.1	Te	Tealson-Rock land association	17,486	2.5
GoE	Gothic loam, 0 to 20 percent slopes	7,970	1.1	Tn	Tine sandy loam	5,943	0.8
Gr	Grafen-Rock outcrop complex	9,275	1.3	ToF	Troutville sandy loam, 15 to 45 percent slopes	3,057	0.4
Gs	Grimstone-Siebert association	9,482	1.3	Tv	Troutville-Newcomb association	8,520	1.2
HaF	Handran extremely stony sandy loam, 20 to 40 percent slopes	1,718	0.2	Wa	Walden sandy loam	9,516	1.3
KaE	Kather clay loam, 5 to 20 percent slopes	12,264	1.7	Wc	Wichup loam	6,905	1.0
LaE	Larand fine sandy loam, 3 to 25 percent slopes	10,100	1.4	YoF	Yochum gravelly sandy loam, 35 to 65 percent slopes	1,928	0.3
LaF	Larand fine sandy loam, 25 to 40 percent slopes	2,508	0.4		Water	3,779	0.5
					Total	712,640	100.0

Runoff is rapid. The hazard of erosion is moderate.

The soils in this association are used mostly for grazing. A small area is irrigated and used for grass hay. Aaberg part in capability unit VIe–2, nonirrigated, and Barishman part in capability units VIe–1, nonirrigated, and VIe–7, irrigated; Aaberg part in Claypan range site, and Barishman part in Dry Mountain Loam range site.

Agneston series

The Agneston series consists of moderately deep, well drained soils that formed in material weathered from granite. The soils are underlain by hard granite bedrock at a depth of 20 to 40 inches. The soils are on mountainsides between elevations of 8,200 and 9,500 feet. Slopes are 5 to 40 percent. The native vegetation is mainly lodgepole pine and a sparse understory of juniper, lupine, and grasses. The mean annual precipitation is 20 to 25 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile the surface layer is light brownish gray gravelly coarse sandy loam about 6

inches thick. The upper part of the subsoil is yellowish brown gravelly coarse sandy clay loam about 14 inches thick, and the lower part is brown very gravelly coarse sandy loam. Granite bedrock is below a depth of 25 inches.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for producing timber and for recreation.

Representative profile of Agneston gravelly coarse sandy loam, 5 to 40 percent slopes, in forest, approximately 100 feet south and 1,500 feet west of northeast corner of sec. 15, T. 11 N., R. 81 W.:

O1—2 inches to 1 inch; undecomposed organic material, principally needles, bark, twigs, and scattered grasses.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.

A2—0 to 6 inches; light brownish gray (10YR 6/2) gravelly coarse sandy loam, grayish brown (10YR 5/2) moist; weak thin platy structure parting to fine granular; soft, very friable, nonsticky and nonplastic; few coarse and medium roots; 20 percent gravel, mostly fine and very fine angular; medium acid; clear smooth boundary.

B2t—6 to 20 inches; yellowish brown (10YR 5/4) gravelly coarse sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium and fine subangular blocky structure; extremely hard, very friable, slightly sticky and slightly plastic; few medium and fine roots; thin continuous clay films on peds, in pores, on coarse fragments, and bridging sand grains; 40 percent gravel, mostly fine and very fine angular; strongly acid; gradual wavy boundary.

B3—20 to 25 inches; brown (7.5YR 5/4) very gravelly coarse sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; very hard, very friable, nonsticky and nonplastic; thin patchy clay films on some peds, on coarse fragments, and bridging some sand grains; 75 percent fine and very fine angular gravel; strongly acid; gradual irregular boundary.

R—25 to 40 inches, granite bedrock.

A thin A1 horizon is present in some places. The A2 horizon is slightly acid to very strongly acid. The B horizon is 35 to 75 percent coarse fragments. The coarse fragments range from ⅛ inch to 10 inches in diameter, but they are mostly less than 3 inches in diameter. The B2t horizon is strongly acid to very strongly acid.

Ag—Agneston gravelly coarse sandy loam, 5 to 40 percent slopes. This soil is on mountainsides.

Included with this soil in mapping are a few small areas of Rock outcrop and very shallow soils in steeper areas and on crests of ridges.

Runoff is slow or medium. The hazard of erosion is severe.

Most of the acreage of this soil is in forest. Capability unit VIIe–2, nonirrigated; not placed in a range site.

Badland

Ba—Badland. This land type consists of nearly barren, dissected, shaly uplands throughout the Area. They are exposures of silty and clayey shales of the Coalmont, North Park, Pierre, Chugwater (Triassic and Jurassic), Benton, and Niobrara Formations. Slopes are generally 10 to 85 percent. Soft shale is at the surface or less than a few inches below the surface.

Runoff is rapid. The hazard of erosion is severe.

This land type is used to a limited extent by wildlife. Capability unit VIIIs–1, nonirrigated; not placed in a range site.

Bangston series

The Bangston series consists of deep, well drained and somewhat excessively drained soils that formed in wind-blown sands. They are on hills and ridges on uplands between elevations of 7,900 and 8,500 feet. Slopes are 1 to 10 percent. The native vegetation is mainly needleandthread, bluebunch wheatgrass, sheep fescue, muttongrass, junegrass, blue grama, and big sagebrush. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 40 days.

In a representative profile the surface layer is dark grayish brown fine sand about 26 inches thick. The underlying material is pale brown loamy sand about 22 inches thick. Very pale brown sand is at a depth of 48 inches.

Permeability is rapid, and available water capacity is low.

These soils are mainly used for grazing. Some areas are used for irrigated hay.

Representative profile of Bangston fine sand, 1 to 10 percent slopes, in native grass, one-half mile south of Sand Creek in the NE¼ sec. 14, T. 9 N., R. 78 W.:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine crumb; slightly hard, very friable; many fine and medium roots; neutral; gradual wavy boundary.

A12—8 to 26 inches; dark grayish brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2.5) moist; massive; soft, very friable; many fine and medium roots; neutral; clear smooth boundary.

C1—26 to 48 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 4/3) moist; massive; slightly hard, very friable; few fine roots; neutral; gradual wavy boundary.

C2—48 to 60 inches; very pale brown (10YR 7/3) sand, brown (10YR 5/3) moist; single grained; loose dry and moist; neutral.

The profile ranges from light sandy loam to sand. The sand grains are fine or medium in size. The profile ranges from neutral to mildly alkaline in reaction. The A horizon ranges from 16 to 40 inches in thickness.

Bg—Bangston fine sand, 1 to 10 percent slopes. This soil is on hills and dunelike topography on uplands.

Included with this soil in mapping are a few small areas of soils that have shale or sandstone at a depth of 40 to 60 inches, small areas of soils that have slopes of as much as 25 percent, and small areas of a nearly level fine sandy loam on terraces.

Runoff is slow. The hazard of soil blowing is severe, and the hazard of water erosion is moderate.

Most of the acreage of this soil is in native grass and is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–5, nonirrigated, and VIe–10, irrigated; Sandy Bench range site.

Barishman series

The Barishman series consists of deep, well drained soils that formed in old alluvial sediment from calcareous shale. The soils are on hills and ridges on uplands between elevations of 8,000 and 8,600 feet. Slopes are 3 to 15 percent. The native vegetation is mainly big sagebrush, low rabbitbrush, streambank wheatgrass, pine needlegrass, muttongrass, sheep fescue, and junegrass. The mean annual precipitation is 9 to 12 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is dark brown loam about 3 inches thick. The subsurface layer is pale brown very fine sandy loam about 9 inches thick. The subsoil is light yellowish brown and light olive brown clay about 32 inches thick. The underlying material is light olive brown clay.

Permeability is slow, and available water capacity is high.

These soils are used mainly for grazing. Some areas are irrigated and used for grass hay.

Representative profile of Barishman loam in an area of Aaberg-Barishman association in native grass, 0.3 mile east and 660 feet north of south quarter-corner of sec. 35, T. 9 N., R. 78 W.:

A1—0 to 3 inches; dark brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; slightly acid; abrupt smooth boundary.

A2—3 to 12 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak thin platy structure parting to moderate fine granular; soft, very friable, nonsticky and slightly plastic; many fine and medium roots; many vesicular pores; slightly acid; abrupt wavy boundary.

B21t—12 to 20 inches; light yellowish brown (10YR 6/4) clay, dark yellowish brown (10YR 4/4) moist; moderate coarse prismatic structure parting to medium angular blocky; extremely hard, friable, very sticky and very plastic; thin continuous clay films on peds and in pores; few fine roots; neutral; gradual wavy boundary.

B22t—20 to 36 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; moderate coarse prismatic structure parting to medium angular blocky; extremely hard, friable, very sticky and very plastic; thin continuous clay films on peds and in pores; few fine roots; mildly alkaline; gradual wavy boundary.

B3ca—36 to 44 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; weak coarse angular blocky structure; extremely hard, firm, very sticky and very plastic; few thin patchy clay films on peds and in pores; few concretions and thin seams of secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

Cca—44 to 60 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; massive; extremely hard, very firm, very sticky and very plastic; concretions and thin seams and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline.

Depth to uniformly calcareous material ranges from 15 to 50 inches, but the upper limit of uniformly calcareous material is no higher than 4 inches below the upper boundary of the B2t horizon. The base of the B2t horizon is at a depth of 12 to 50 inches. Reaction ranges from slightly acid in the A horizon to very strongly alkaline in the C horizon. Calcium carbonate equivalent of the Cca horizon ranges from about 4 to 14 percent. The Cca horizon is typically clay or heavy clay loam that is more than 35 percent clay.

Barishman soils are mapped only in association with Aaberg soils.

Blackwell series

The Blackwell series consists of deep, poorly drained soils that formed in mixed alluvium. In places they are underlain by very gravelly sand at a depth of 40 to 60 inches. The soils are on low terraces and flood plains along streams and drainageways between elevations of 7,900 and 8,800 feet. Slopes are 0 to 5 percent. The native vegetation is mainly tufted hairgrass, Nebraska sedge, ovalhead sedge, Baltic rush, Thurber fescue, slender wheatgrass, and willows. The mean annual precipitation is 10 to 20 inches, the mean annual air temperature is 35° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile about 2½ inches of slightly decomposed grass roots, stems, and leaves are on the surface. The surface layer is very dark grayish brown loam about 13 inches thick. The subsoil is light brownish gray sandy clay loam and gravelly loam about 33 inches thick. The underlying material is very gravelly sand.

Permeability is moderately slow, and available water capacity is high.

These soils are used mainly for irrigated hay and pasture.

Representative profile of Blackwell loam in hay meadow, 200 feet east of the west quarter-corner of sec. 31, T. 6 N., R. 78 W.:

O1—2½ inches to 0; slightly decomposed organic mat of dead grass roots, stems, and leaves.

A1—0 to 13 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, firm, nonsticky; many fine and medium roots; neutral; gradual smooth boundary.

B21g—13 to 21 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4.5/2) moist; common distinct reddish brown (5YR 4/4) mottles moist; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, firm, slightly sticky; 10 percent fine gravel; neutral; gradual wavy boundary.

B22g—21 to 46 inches; light brownish gray (2.5Y 6/2) gravelly loam, dark grayish brown (2.5Y 4.5/2) moist; common distinct reddish brown (5YR 4/4) mottles moist; massive; hard, firm, slightly sticky; 10 percent cobbles; neutral; gradual wavy boundary.

IIC—46 to 60 inches; very gravelly sand.

The water table is at a depth of 10 to 20 inches. Reaction is slightly acid to neutral. The organic mat on the surface ranges from 1 to 4 inches in thickness. The IIC horizon ranges from very gravelly sandy loam to very gravelly sand. It is below a depth of 40 inches.

Bk—Blackwell loam. This soil is on low terraces and flood plains along rivers and streams. Slopes are 0 to 5 percent.

Included with this soil in mapping adjacent to stream channels are a few small areas of soils that are similar to Blackwell soils but that are underlain by sand and gravel at a depth of 20 to 40 inches. Also included are small areas of Dobrow soils, small areas of a soil that is silt loam throughout, and small areas of strongly alkaline soils.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is irrigated and is used for grass hay and pasture. Capability units VIw–1, nonirrigated, and VIw–2, irrigated; Mountain Meadow range site.

Blevinton series

The Blevinton series consists of deep, well drained soils that formed in alluvium and eolian sands. The soils are in concave areas on sides of valleys between elevations of 8,000 and 9,500 feet. Slopes are 8 to 20 percent. The native vegetation is mainly Idaho fescue, big bluegrass, western wheatgrass, nodding brome, buckwheat, sedges, and big sagebrush. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is dark grayish brown and brown sandy loam and fine sandy loam about 30 inches thick. The subsoil is brown fine sandy loam about 18 inches thick. The underlying material is brown fine sandy loam.

Permeability is moderately rapid, and available water capacity is moderate. These soils receive additional water as runoff from higher lying areas in spring.

These soils are used mainly for grazing.

Representative profile of Blevinton sandy loam, 8 to 20 percent slopes, in native range, 2,500 feet east and 500 feet south of the west quarter-corner of sec. 36, T. 7 N., R. 9 W.:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, friable, nonsticky and nonplastic; many fine and medium roots; neutral; gradual smooth boundary.

A12—8 to 20 inches; dark grayish brown (10YR 4/2) light fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; gradual smooth boundary.

A3—20 to 30 inches; brown (10YR 5/3) light fine sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; gradual smooth boundary.

B2t—30 to 48 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak very coarse prismatic structure parting to coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; few fine roots; thin patchy clay films on some peds and in pores and as thin bridging between sand grains; neutral; gradual smooth boundary.

C—48 to 60 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; neutral.

The profile ranges from slightly acid to mildly alkaline. The A11 and A12 horizons range from 12 to 20 inches in thickness. The upper boundary of the B2t horizon is at a depth of 24 to 40 inches.

Bn—Blevinton sandy loam, 8 to 20 percent slopes. This soil is in concave areas and on sides of alluvial fans and drainageways where snow accumulates.

Included with this soil in mapping are a few small areas of Tiagos fine sandy loam in less sloping areas.

Runoff is slow. The hazards of soil blowing and water erosion are moderate.

Most of the acreage of this soil is used for grazing. Capability unit VIe–3, nonirrigated; Mountain Loam range site.

Boettcher series

The Boettcher series consists of moderately deep, well drained soils that formed in material weathered from Coalmont Shale. The soils are underlain by soft shale bedrock at a depth of 20 to 40 inches. The soils are on hills, ridges, and sides of terraces on uplands between elevations of 8,000 and 8,800 feet. Slopes are 2 to 10 percent. The native vegetation is mainly western wheatgrass, muttongrass, bluebunch wheatgrass, pine needlegrass, low rabbitbrush, greasewood, and big sagebrush. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is light brownish gray clay loam about 4 inches thick. The subsoil is brown clay about 18 inches thick and is calcareous in the lower part. The underlying material is pale brown clay. Calcareous shale is at a depth of 29 inches.

Permeability is slow, and available water capacity is low.

These soils are used mainly for grazing. Some areas are irrigated and used for hay and pasture.

Representative profile of Boettcher clay loam in an area of Boettcher-Bundyman association in native grass, 1,400 feet east and 100 feet south of northwest corner of sec. 20, T. 8 N., R. 79 W.:

A1—0 to 4 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; strong very fine granular structure; soft, very friable, slightly sticky and slighty plastic; 5 percent gravel; few fine and medium roots; many vesicular pores in upper ½ inch (crust); mildly alkaline; gradual smooth boundary.

B2t—4 to 15 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to coarse and medium angular blocky; extremely hard, very friable, sticky and plastic; thin continuous clay films on peds and in pores; 5 percent gravel; few fine roots; mildly alkaline; diffuse wavy boundary.

B3ca—15 to 22 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate coarse angular blocky; extremely hard, firm, very sticky and very plastic; thin patchy clay films on peds and in pores; some concretions of secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

C1ca—22 to 29 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive; extremely hard, very firm, very sticky and very plastic; some concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

C2r—29 to 60 inches; calcareous shale.

Depth to uniformly calcareous material ranges from 6 to 40 inches. The A horizon is neutral or mildly alkaline. The C horizon is moderately alkaline or strongly alkaline. Calcium carbonate equivalent of the C horizon ranges from about 4 to 10 percent.

Bo—Boettcher-Bundyman association. This association is on hills, ridges, and sides of terraces on uplands.

This association is about 70 percent Boettcher clay loam and about 30 percent Bundyman clay loam. The Boettcher soil generally is in higher areas; slopes are slightly convex and are 2 to 10 percent. The Bundyman soil is in lower areas; it is slightly concave or flat, and slopes are 2 to 5 percent.

Included with this association in mapping are small areas of Spicerton soils adjacent to drainageways and a few small areas of gravelly outwash on higher terraces or benches.

Runoff is medium or rapid. The hazards of soil blowing and water erosion are moderate.

The soils in this association are used mainly for grazing. A small acreage is irrigated and is used for grass hay and pasture. Capability units VIe–2, nonirrigated, and VIe–7, irrigated; Alkaline Slopes range site.

Bosler series

The Bosler series consists of deep, well drained soils that formed in outwash or old gravelly alluvium. The soils are underlain by very gravelly coarse sandy loam at a depth of 20 to 40 inches. They are on high terraces and benches between elevations of 7,800 and 8,300 feet. Slopes are 2 to 5 percent. The native vegetation is mainly pine needlegrass, junegrass, muttongrass, streambank wheatgrass, low rabbitbrush, and big sagebrush. The mean annual precipitation is 9 to 12 inches, the mean annual air temperature is 37° to 39° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is brown sandy loam about 3 inches thick. The subsoil is brown sandy clay loam about 12 inches thick. The underlying material is light olive brown sandy loam. Very gravelly loamy coarse sand is at a depth of about 21 inches. A zone of lime accumulation is below a depth of about 11 inches.

Permeability is moderate, and available water capacity is moderate.

These soils are mainly used for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Bosler sandy loam in native grass, center of sec. 7, T. 9 N., R. 79 W.:

A1—0 to 3 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak fine crumb structure; loose, very friable, nonsticky; many fine and medium roots; scattered gravel on surface; slightly acid; clear smooth boundary.

B2t—3 to 11 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, firm, slightly sticky; many fine and medium roots; thin patchy clay films on faces of peds; 5 percent gravel; slightly acid; gradual smooth boundary.

B3ca—11 to 15 inches; brown (10YR 5/3) light sandy clay loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky; few fine roots; few thin clay films on peds; 5 percent gravel; strongly calcareous; mildly alkaline; clear wavy boundary.

Cca—15 to 21 inches; light olive brown (2.5Y 5/4) sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky; 10 percent gravel; concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; strongly alkaline; abrupt smooth boundary.

IIC—21 to 60 inches; very gravelly loamy coarse sand; 60 percent gravel; strongly calcareous.

Depth to calcareous material ranges from 5 to 14 inches. The A horizon is slightly acid to mildly alkaline. The B2t horizon is slightly acid to moderately alkaline. The B3ca and Cca horizons are mildly alkaline to strongly alkaline. The Cca horizon contains 15 to 30 percent calcium carbonate. Depth to very gravelly material is 20 to 40 inches.

Bs—Bosler sandy loam. This soil is on high terraces and benches. Slopes are 2 to 5 percent.

Included with this soil in mapping are a few small areas of soils that are similar to Bosler soils but that are more than 35 percent gravel throughout. Also included are small areas of Tiagos fine sandy loam on the downwind side of small ridges.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and is used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–9, irrigated; Valley Bench range site.

Bowen series

The Bowen series consists of moderately deep, well drained soils that formed in highly micaceous weathered schist or micaceous gneiss. The soils are underlain by hard bedrock at a depth of 20 to 40 inches. They are on mountainsides and ridges between elevations of 8,500 and 9,500 feet. Slopes are 15 to 45 percent. The native vegetation is mainly bluebunch wheatgrass, mountain muhly, sheep fescue, pine needlegrass, junegrass, big sagebrush, and low rabbitbrush. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 30 to 35 days.

In a representative profile the surface layer is dark grayish brown gravelly sandy loam about 7 inches thick. The upper part of the subsoil is brown gravelly heavy sandy loam about 3 inches thick; the middle part is yellowish brown very gravelly sandy clay loam about 8 inches thick; the lower part is very gravelly heavy sandy loam about 4 inches thick. The underlying material is pale brown very gravelly sandy loam. Bedrock is at a depth of about 28 inches.

Permeability is moderately rapid, and the available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Bowen gravelly sandy loam, 15 to 45 percent slopes, in native grass, 1,280 feet east and 390 feet north of west quarter-corner of sec. 16, T. 11 N., R. 80 W.:

A1—0 to 7 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many medium and few fine roots; 30 percent gravel, small amount of cobbles; enough mica fragments to give soaplike consistence when moist and crushed; neutral; clear smooth boundary.

B1—7 to 10 inches; brown (10YR 5/3) gravelly heavy sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to medium granular; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; 45 percent gravel, small amount of cobbles; few thin patchy clay films on peds, on coarse frag-

ments, and in pores; enough mica fragments to give soaplike consistence when moist and crushed; neutral; clear smooth boundary.

B2t—10 to 18 inches; yellowish brown (10YR 5/4) very gravelly sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine roots; 60 percent gravel and cobbles; thin continuous clay films on peds, on coarse fragments, and in pores; mica fragments give soaplike consistence when moist and crushed; neutral; gradual smooth boundary.

B3—18 to 22 inches; yellowish brown (10YR 5/4) very gravelly heavy sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 60 percent gravel, small amount of cobbles; thin patchy clay films on peds, on some coarse fragments, and in some pores; enough mica fragments to give soaplike consistence when moist and crushed; neutral; gradual wavy boundary.

C—22 to 28 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 70 percent gravel and cobbles; enough mica fragments to give soaplike consistence when moist and crushed; neutral; clear wavy boundary.

R—28 to 40 inches; hard schist or micaceous gneiss bedrock.

Content of coarse fragments ranges from 35 to 80 percent. Sand and silt fractions are about 2 to 20 percent or more flat mica platelets large enough to influence physical properties of the soil. Reaction ranges from slightly acid to mildly alkaline throughout. The B2t horizon is gravelly or very gravelly sandy clay loam.

Bw—Bowen gravelly sandy loam, 15 to 45 percent slopes. This soil is on mountainsides and ridges.

Included with this soil in mapping are a few small areas of Rock outcrop and very shallow soils on crests of ridges and slope breaks. Surface rock as large as 3 feet in diameter is in most areas. Small areas of Rogert gravelly sandy loam are also included.

Runoff is medium and rapid. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage of this soil is used for grazing. Capability unit VIIs–1, nonirrigated; Rocky Loam range site.

Brinkert series

The Brinkert series consists of deep, well drained soils that formed in old alluvial fan sediments. They are on old alluvial fans and high terraces between elevations of 8,000 and 9,000 feet. Slopes are 5 to 12 percent. The native vegetation is mainly streambank wheatgrass, pine needlegrass, muttongrass, winterfat, junegrass, alkali sagebrush, and rabbitbrush. The mean annual precipitation is 12 to 16 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is grayish brown loam about 5 inches thick. The subsoil is brown light to heavy clay loam about 15 inches thick. The underlying material is brown sandy clay loam.

Permeability is moderately slow, and available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Brinkert loam in an area of Brinkert-Morset association in native grass, 600 feet east and 1,050 feet south of the northwest corner of sec. 36, T. 8 N., R. 79 W.:

A1—0 to 5 inches, grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to fine granular; soft, very friable, slightly sticky and slightly plastic; many fine and few medium roots; 10 percent gravel; neutral; clear smooth boundary.

B1—5 to 8 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to medium subangular blocky; hard, very friable, slightly sticky and slightly plastic; many fine and few medium roots; 10 percent gravel; thin patchy clay films on some peds; neutral; clear smooth boundary.

B2t—8 to 20 inches; brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to medium angular blocky; extremely hard, very firm, sticky and plastic; few fine roots; 10 percent gravel; thin nearly continuous clay films on peds and in pores; mildly alkaline; clear smooth boundary.

B3—20 to 25 inches; brown (10YR 5/3) heavy sandy clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to coarse angular blocky; very hard, friable, slightly sticky and slightly plastic; many thin patchy clay films on peds and in some pores; mildly alkaline; gradual wavy boundary.

C—25 to 60 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; very hard, firm, slightly sticky and slightly plastic; 10 percent gravel; mildly alkaline.

Content of coarse fragments ranges from 0 to 15 percent, by volume. Reaction ranges from slightly acid to mildly alkaline. The B2t horizon is heavy clay loam or light clay.

Bx—Brinkert-Morset association. This association is on old alluvial fans and high terraces. Slopes are 5 to 12 percent. The association is about 60 percent Brinkert loam and about 40 percent Morset loam. The Brinkert soil is on the broad, interridge areas, and the Morset soil is on long, narrow, low ridges.

Included with this association in mapping are a few small areas of Tiagos fine sandy loam on small ridges.

Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

The soils in this association are mostly used for grazing. A small acreage is irrigated and used for hay and pasture. Brinkert part in capability units VIe–1, nonirrigated, and VIe–7, irrigated, and Morset part in capability units VIe–3, nonirrigated, and VIe–9, irrigated; Brinkert part in Claypan range site, and Morset part in Dry Mountain Loam range site.

Buffmeyer series

The Buffmeyer series consists of deep, well drained soils that formed in gravelly alluvium and fan sediments. They are on alluvial fans and terraces between elevations of 8,200 and 9,200 feet. Slopes are 4 to 18 percent. The native vegetation is mainly Idaho fescue, wheatgrasses, Sandberg bluegrass, needlegrasses, squirreltail, junegrass, snowberry, and big sagebrush. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 33° to 34° F, and the frost-free season is 25 to 35 days.

In a representative profile the surface layer is grayish brown light sandy loam about 8 inches thick. The subsurface layer is very pale brown light sandy loam about 5 inches thick. The subsoil is brown and

yellowish brown gravelly sandy loam about 33 inches thick; it is about 50 percent gravel. The underlying material is light yellowish brown gravelly light sandy loam.

Permeability is moderately rapid, and the available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Buffmeyer sandy loam, 4 to 18 percent slopes, in native grass, 800 feet north of southwest corner of sec. 9, T. 10 N., R. 78 W.:

A1—0 to 8 inches; grayish brown (10YR 5/2) light sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 5 percent gravel and cobbles; neutral; clear smooth boundary.

A2—8 to 13 inches; very pale brown (10YR 7/3) light sandy loam, brown (10YR 5/3) moist; weak thin platy structure parting to fine granular; soft, very friable, nonsticky and nonplastic; many fine and few medium roots; 5 percent gravel and cobbles; neutral; clear smooth boundary.

B21t—13 to 21 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; 40 percent gravel and some cobbles; many thin patchy clay films on peds, in some pores, and bridging between some sand grains; neutral; gradual wavy boundary.

B22—21 to 40 inches; yellowish brown (10YR 5/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; 50 percent gravel and some cobbles; many thin patchy clay films on peds, in pores, and bridging between sand grains; neutral; gradual wavy boundary.

B3—40 to 46 inches; yellowish brown (10YR 5/4) gravelly light sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 50 percent gravel and some cobbles; few thin patchy clay films on peds and as bridges between sand grains; neutral; diffuse wavy boundary.

C—46 to 60 inches; light yellowish brown (10YR 6/4) gravelly light sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 50 percent gravel and some cobbles; neutral.

The B2t and C horizons are 35 to 70 percent coarse fragments ¼ inch to 10 inches in diameter.

By—Buffmeyer sandy loam, 4 to 18 percent slopes. This soil is on alluvial fans and high terraces, below areas of crystalline rock.

Included with this soil in mapping are a few small areas of soils that are similar to Buffmeyer soils but that have a sandy clay or clay loam B horizon or that have less than 35 percent coarse fragments and are moderately deep over red shale beds.

Runoff is slow. The hazards of soil blowing and water erosion are moderate.

Most of the acreage of this soil is used for grazing. Capability unit VIe–3, nonirrigated; Mountain Loam range site.

Bundyman series

The Bundyman series consists of moderately deep, well drained soils that formed in weathered shale. The soils are underlain by calcareous shale at a depth of 20 to 40 inches. They are on hills and ridges on uplands between elevations of 8,000 and 8,800 feet. Slopes are 2 to 5 percent. The native vegetation is mainly western wheatgrass, mat saltbush, Sandberg bluegrass, pine needlegrass, big sagebrush, and greasewood. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is light brownish gray clay loam about 4 inches thick. The subsoil is pale brown heavy clay loam about 9 inches thick. The underlying material is pale brown heavy clay loam. Calcareous shale is at a depth of about 25 inches.

Permeability is slow, and available water capacity is low.

These soils are used mainly for grazing. Some areas are irrigated and are used for hay and pasture.

Representative profile of Bundyman clay loam in an area of Boettcher-Bundyman association in native grass, 425 feet east and 250 feet south of the northwest corner of sec. 20, T. 8 N., R. 79 W.:

A1—0 to 4 inches; light brownish gray (10YR 6/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; mildly alkaline; gradual wavy boundary.

B2—4 to 13 inches; pale brown (10YR 6/3) heavy clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to coarse angular blocky; slightly hard, friable, sticky and plastic; few fine roots; patchy clay films on peds and in pores; mildly alkaline; gradual wavy boundary.

Cca—13 to 25 inches; pale brown (10YR 6/3) heavy clay loam, brown (10YR 4/3) moist; massive; extremely hard, very firm, sticky and plastic; concretions and thin seams of secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

C2r—25 to 60 inches; calcareous shale.

The A1 horizon is neutral or mildly alkaline. The B2 horizon is heavy clay loam or clay. The B2 horizon ranges from neutral to moderately alkaline. Calcium carbonate equivalent of the Cca horizon ranges from 3 to 14 percent. The Cca horizon is moderately alkaline or strongly alkaline.

Bundyman soils are mapped only in association with Boettcher soils.

Cabin series

The Cabin series consists of deep, well drained soils that formed in gravelly alluvium. The soils are underlain by very gravelly sand at a depth of 20 to 40 inches. They are on high terraces and benches between elevations of 8,200 and 9,200 feet. Slopes are 2 to 5 percent. The native vegetation is mainly sheep fescue, pine needlegrass, muttongrass, streambank wheatgrass, bluebunch wheatgrass, big sagebrush and low rabbitbrush. The mean annual precipitation is 15 to 16 inches, the mean annual air temperature is 35° to 37° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is dark grayish brown sandy loam about 4 inches thick. The subsoil is brown gravelly sandy clay loam and pale brown very gravelly sandy loam about 22 inches thick. The underlying material is pale brown very gravelly sand.

Permeability is moderate above a depth of about 26 inches and rapid below that depth. The available water capacity is low.

These soils are mainly used for grazing. Some areas are irrigated and used for hay and pasture.

Representative profile of Cabin sandy loam in native grass, 800 feet west and 425 feet south of the northeast corner of sec. 15, T. 6 N., R. 79 W.:

A1—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 10 percent gravel; mildly alkaline; clear smooth boundary.

B1—4 to 8 inches; brown (10YR 4/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; few thin patchy clay films on peds; mildly alkaline; gradual wavy boundary.

B2t—8 to 17 inches; brown (10YR 5/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; 25 percent gravel; thin nearly continuous clay films on peds, sand grains, and gravel and as bridges between sand grains; mildly alkaline; diffuse wavy boundary.

B3—17 to 26 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 58 percent gravel; thin patchy clay films on peds; mildly alkaline; diffuse wavy boundary.

IIC—26 to 60 inches; pale brown (10YR 6/3) very gravelly sand, brown (10YR 5/3) moist; single grained; loose; 70 percent gravel; mildly alkaline.

The A1 horizon is fine sandy loam or sandy loam 4 to 10 inches thick. It contains 5 to 20 percent coarse fragments. It is slightly acid to moderate alkaline. The B2t horizon is 15 to 35 percent coarse fragments. It is medium acid to mildly alkaline. The contrasting IIC horizon is slightly acid to mildly alkaline.

Ca—Cabin sandy loam. This soil is on old terraces and high glacial benches. Slopes are 2 to 5 percent.

Included with this soil in mapping are a few small areas of soils that are similar to Cabin soils but that have pockets of calcareous material in the IIC horizon or that are less than 5 feet deep over sandstone or shale of the Coalmont Formation. Also included are small areas of Tiagos soils on narrow, low ridges.

Runoff is medium. The hazard of soil blowing is severe, and the hazard of water erosion is moderate.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–10, irrigated; Dry Mountain Loam range site.

Carlstrom series

The Carlstrom series consists of moderately deep, well drained soils that formed in weathered shale. The soils are underlain by clay shale at a depth of 20 to 40 inches. They are on rolling uplands between elevations of 8,000 and 8,800 feet. Slopes are 5 to 15 percent. The native vegetation is mainly bluebunch wheatgrass, pine needlegrass, muttongrass, western wheatgrass, junegrass, big sagebrush, and low rabbitbrush. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 37° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is brown clay about 7 inches thick. The underlying material is pale brown clay. Shale is at a depth of about 26 inches.

Permeability is slow, and available water capacity is low.

These soils are used mainly for grazing. Some areas are used for irrigated hay.

Representative profile of Carlstrom clay in an area of Crespin-Carlstrom clays in native grass, 1,200 feet west and 1,050 feet north of the center of sec. 23, T. 9 N., R. 79 W.:

A1—0 to 3 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate fine granular structure; soft, very friable, sticky and plastic; many fine and medium roots; mildly alkaline; clear smooth boundary.

AC—3 to 7 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak coarse angular blocky structure parting to medium angular blocky; extremely hard, very firm, sticky and plastic; few medium and many fine roots; mildly alkaline; gradual wavy boundary.

C1—7 to 26 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive; extremely hard, very firm, sticky and plastic; mildly alkaline; gradual wavy boundary.

C2r—26 to 40 inches; shale.

The profile is generally noncalcareous throughout, but a very thin, discontinuous, weakly calcareous horizon is immediately above the shale in some places. Reaction ranges from slightly acid to moderately alkaline.

Carlstrom soils are mapped only in association with Crespin soils.

Chedsey series

The Chedsey series consists of moderately deep, well drained soils that formed in material weathered from Chugwater Shale. The soils are underlain by weathered shale at a depth of 20 to 40 inches. They are on valley sides and mountain toe slopes between elevations of 8,200 and 9,000 feet. Slopes are 5 to 12 percent. The native vegetation is mainly Idaho fescue, big bluegrass, western wheatgrass, nodding brome, buckwheat, big sagebrush, and low rabbitbrush. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 35° to 37° F, and the frost-free season is 30 to 35 days.

In a representative profile, a layer of undecomposed organic material 1 inch thick is on the surface. The surface layer is brown loam about 6 inches thick. The subsurface layer is light brown loam about 7 inches thick. The subsoil is reddish brown clay loam about 23 inches thick. The underlying material is soft reddish brown interbedded shale and siltstone.

Permeability is slow, and available water capacity is moderate.

These soils are used mainly for grazing.

Representative profile of Chedsey loam, 5 to 12 percent slopes, in native grass, 500 feet west and 1,225 feet north of the southeast corner of sec. 6, T. 11 N., R. 81 W.:

O1—1 inch to 0; undecomposed organic material, mainly grass and grass roots.
A1—0 to 6 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/3) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 5 percent gravel; neutral; clear smooth boundary.
A2—6 to 13 inches; light brown (7.5YR 6/3) loam, brown (7.5YR 5/3) moist; weak thick platy structure parting to fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many medium roots; 10 percent gravel; mildly alkaline; gradual wavy boundary.
B2t—13 to 30 inches; reddish brown (5YR 5/3) heavy clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular and angular blocky structure; extremely hard, very firm, sticky and plastic; few fine and medium roots; 5 percent gravel; moderate continuous clay films on peds and in pores; mildly alkaline; clear wavy boundary.
B3ca—30 to 36 inches; reddish brown (5YR 5/3) light clay loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; 5 percent gravel; thin patchy clay films on peds and in some pores; concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.
Cr—36 to 60 inches; soft reddish brown interbedded calcareous shale and siltstone.

The profile is 0 to 15 percent coarse fragments, mostly gravel. The A horizon is neutral or mildly alkaline. The B2t horizon is heavy clay loam or light clay. The B2t horizon is neutral to moderately alkaline. Calcium carbonate equivalent of the B3ca horizon ranges from 3 to 10 percent. The B3ca horizon, or the Cca horizon if present, is moderately alkaline or strongly alkaline.

Cd—Chedsey loam, 5 to 12 percent slopes. This soil is on valley sides and mountain toe slopes.

Included with this soil in mapping on slope breaks and in steeper areas are a few small areas of soils that are very shallow over red-bed shale. Also included are small areas of Rawah soils.

Runoff is rapid. The hazard of soil blowing is moderate and the hazard of water erosion is severe.

Most of the acreage of this soil is used for grazing. Capability unit VIe–1, nonirrigated; Mountain Loam range site.

Coalmont series

The Coalmont series consists of moderately deep, well drained soils that formed in material weathered from Coalmont Shale. The soils are underlain by soft shale at a depth of 20 to 40 inches. They are on hills and ridges on uplands between elevations of 8,000 and 8,300 feet. Slopes are 5 to 12 percent. The native vegetation is mainly alkali sagebrush, streambank wheatgrass, pine needlegrass, muttongrass, winterfat, junegrass, squirreltail, and low rabbitbrush. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 37° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is light brownish gray loam about 4 inches thick. The subsoil is grayish brown and light brownish gray clay about 16 inches thick. The underlying material is light yellowish brown clay loam. Calcareous clay shale is at a depth of about 30 inches.

Permeability is slow, and available water capacity is low.

These soils are used mainly for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Coalmont loam in an area of Coalmont-Fluetsch complex, in native grass, 780 feet west and 780 feet north of southeast corner of sec. 19, T. 8 N., R. 79 W.:

A1—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; some bleached sand grains; mildly alkaline; abrupt smooth boundary.
B21t—4 to 10 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; strong coarse prismatic structure parting to coarse angular blocky; extremely hard, firm, very sticky and plastic; few fine and medium roots; thin continuous clay films on peds and in pores; mildly alkaline; clear wavy boundary.
B22t—10 to 16 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to coarse angular blocky; extremely hard, firm, sticky and plastic; few fine roots; thin nearly continuous clay films on peds and in pores; slightly calcareous; moderately alkaline; gradual wavy boundary.
B3ca—16 to 20 inches; light brownish gray (10YR 6/2) light clay, dark grayish brown (10YR 4/2) moist; weak coarse angular blocky structure; extremely hard, firm, sticky and plastic; few patchy clay films on peds and in pores; concretions and thin seams of calcium carbonate; strongly calcareous; moderately alkaline; diffuse wavy boundary.
Cca—20 to 30 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; very hard, firm, sticky and plastic; concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline; diffuse wavy boundary.
Cr—30 to 60 inches; calcareous clay shale.

The profile is 0 to 10 percent coarse fragments. Depth to uniformly calcareous material ranges from 6 to 30 inches. The A horizon is slightly acid to mildly alkaline. The B2t horizon is heavy clay loam or light clay. The B2t horizon is slightly acid to moderately alkaline. The C horizon is moderately alkaline or strongly alkaline. The calcium carbonate equivalent in the B3ca and Cca horizons ranges from about 3 to 14 percent.

Cf—Coalmont-Fluetsch complex. This complex is on hills and ridges on uplands in the central part of the Area. Slopes are 5 to 12 percent. The complex is about 50 percent Coalmont loam, about 30 percent Fluetsch sandy loam, and about 20 percent Cryorthents, steep. The Fluetsch soil is in narrow, ribbonlike areas surrounded by the Coalmont soil; thus the complex has a banded appearance (fig. 2). The Cryorthents, steep, are on ridges and sides of drainageways.

Included with this complex in mapping are a few small areas of Aaberg clay. Also included are small areas of soils that are similar to Coalmont soils but that have strongly developed columnar structure.

Runoff is medium or rapid. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

The soils in this complex are used mostly for grazing. A small acreage is irrigated and used for hay and pasture. Coalmont part in capability units VIe–2, nonirrigated, and VIe–7, irrigated, and Fluetsch part in capability units VIe–3, nonirrigated, and VIe–9, irrigated; Coalmont part in Claypan range site, and Fluetsch part in Valley Bench range site.

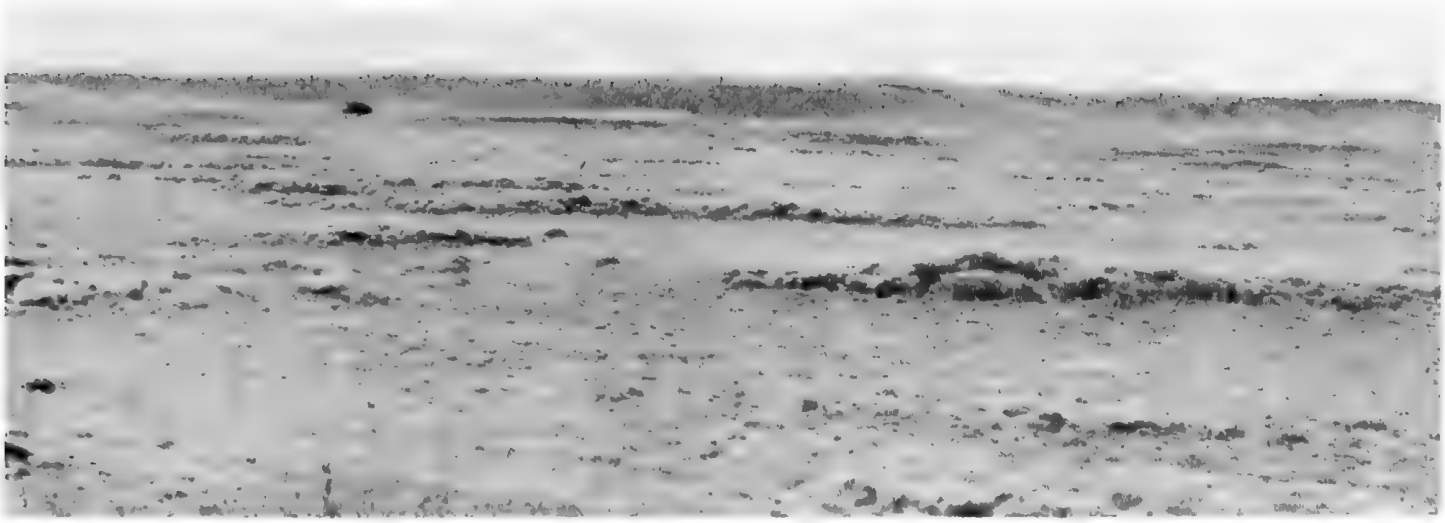

Figure 2.—**Area of Coalmont-Fluetsch complex. Fluetsch soils support big sagebrush; Coalmont soils support only low alkali sagebrush.**

Cowdrey series

The Cowdrey series consists of deep, well drained soils that formed in fine-textured glacial till. They are on mountainsides between elevations of 7,800 and 9,300 feet. Slopes are 4 to 50 percent. The native vegetation is mainly lodgepole pine, Englemann spruce, and subalpine fir and an understory of vaccinium, heartleaf arnica, elk sedge, oregongrape, and kinnikinnick. The mean annual precipitation is 16 to 22 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile the surface layer is very dark gray loam about 3 inches thick. The subsurface layer is light gray light clay loam about 5 inches thick. The next 4 inches is a mixture of light gray light clay loam of the subsurface layer and brown light clay of the subsoil. The upper part of the subsoil is brown light clay about 12 inches thick, and the lower part of the subsoil is light olive brown gravelly clay about 6 inches thick. The underlying material is light olive gray clay.

Permeability is slow, and available water capacity is high.

These soils are used mainly for producing timber. Some areas have been cleared and are used for irrigated hay and pasture.

Representative profile of Cowdrey loam, 4 to 10 percent slopes, in forest, 1,900 feet north of the south quarter-corner of sec. 24, T. 7 N., R. 77 W.:

O1—4 inches to 1 inch; undecomposed organic material, mainly needles, bark, and twigs.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.

A1—0 to 3 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; strong fine crumb structure; soft, very friable, slightly sticky and slightly plastic; many coarse to fine roots; 5 percent gravel and cobbles; neutral; abrupt wavy boundary.

A2—3 to 8 inches; light gray (10YR 7/2) light clay loam, grayish brown (10YR 5/2) moist; moderate medium platy structure parting to strong fine granular; soft, very friable, sticky and plastic; many coarse and medium roots; 10 percent gravel and cobbles; slightly acid; gradual wavy boundary.

A&B—8 to 12 inches; mixed light gray (10YR 7/2) light clay loam, grayish brown (10YR 5/2) moist, and brown (10YR 5/3) light clay, dark brown (10YR 4/3) moist; strong fine angular blocky structure; very hard, very friable, sticky and plastic; many fine and medium roots; few thin patchy clay films on peds; horizon consists of fragments of material similar to that of underlying horizon embedded in lighter colored matrix similar to that of overlying horizon; slightly acid; clear smooth boundary.

B2t—12 to 24 inches; brown (10YR 5/3) light clay, dark brown (10YR 4/3) moist; strong medium and fine angular blocky structure; extremely hard, friable, very sticky and very plastic; few coarse to fine roots; 15 percent gravel; thin continuous clay films on peds; neutral; gradual wavy boundary.

B3—24 to 30 inches; light olive brown (2.5Y 5/4) gravelly clay, olive brown (2.5Y 4/4) moist; weak medium angular blocky structure; very hard, firm, very sticky and very plastic; few coarse roots; 25 percent gravel; many thin patchy clay films on peds and in some pores; neutral; diffuse wavy boundary.

C—30 to 60 inches; light olive gray (5Y 6/2) clay, olive gray (5Y 5/2) moist; massive; extremely hard, very firm, very sticky and very plastic; 15 percent gravel and cobbles; neutral.

The profile typically is noncalcareous to a depth of more than 60 inches, but in places it is calcareous between depths of 40 and 60 inches. The thin A1 horizon is absent in some places. The A and B2t horizons are neutral or slightly acid. The C horizon is neutral to moderately alkaline.

CoD—Cowdrey loam, 4 to 10 percent slopes. This soil is on mountainsides and old glacial plains in the southern part of the Area. It has the profile described as representative of the series.

Included with this soil in mapping are a few narrow rock streams, generally less than 50 feet wide. Also included are small parks of Gothic soils.

Runoff is rapid. The hazard of soil blowing is slight and the hazard of water erosion is moderate.

Most of the acreage of this soil is in forest. A small acreage is cleared and used for irrigated hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Ca-

pability units VIe–1, nonirrigated, and VIe–7, irrigated; not placed in a range site.

CoF—Cowdrey loam, 10 to 50 percent slopes. This soil is on mountainsides and on side slopes of old glacial plains in the southern part of the Area.

Included with this soil in mapping are a few narrow rock streams, generally less than 50 feet wide, and a few scattered areas in which a large amount of rock is at the surface. Also included are small parks of Gothic soils.

Runoff is rapid. The hazard of soil blowing is slight, and the hazard of water erosion is severe.

Most of the acreage of this soil is in forest. Capability unit VIIe–1, nonirrigated; not placed in a range site.

Crespin series

The Crespin series consists of deep, well drained soils that formed in material derived from weathered shale. They are on fans and valley sides on uplands between elevations of 8,000 and 8,800 feet. Slopes are 5 to 15 percent. The native vegetation is mainly bluebunch wheatgrass, pine needlegrass, muttongrass, western wheatgrass, junegrass, buckwheat, big sagebrush, low rabbitbrush, and serviceberry. The mean annual precipitation is 9 to 12 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile the soil is brown clay 60 inches or more thick.

Permeability is slow, and available water capacity is high.

These soils are used mainly for grazing.

Representative profile of Crespin clay in an area of Crespin-Carlstrom clays in native grass, one-quarter mile west and one-eighth mile south of the northeast corner of sec. 23, T. 9 N., R. 79 W.:

A1—0 to 4 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong fine granular structure; slightly hard, very friable, sticky and plastic; many fine and medium roots; mildly alkaline; clear smooth boundary.

AC—4 to 9 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; cracks 1 to 3 centimeters wide when dry; mildly alkaline; gradual wavy boundary.

C—9 to 60 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; very weak very coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; numerous slickensides and pressure faces; cracks 1 to 3 centimeters wide when dry; mildly alkaline.

The profile is heavy clay loam to clay. It is 0 to 10 percent coarse fragments. Reaction ranges from slightly acid to mildly alkaline.

Cr—Crespin-Carlstrom clays. This complex is on uplands and valley sides. Slopes are 5 to 15 percent. This complex is about 55 percent Crespin clay and about 35 percent Carlstrom clay. The soils in this complex have the profiles described as representative of their respective series.

Included in mapping are about 10 percent Sudduth soils in low or depressional areas.

Runoff is rapid. The hazard of soil blowing is severe, and the hazard of water erosion is moderate.

This complex is used mainly for grazing. Crespin part in capability unit VIe–1, nonirrigated, and Carlstrom part in capability unit VIe–2, nonirrigated; Mountain Shale range site.

Cs—Crespin-Carlstrom stony clays. This complex is on stone-covered uplands and valley sides in the southwestern part of the survey area. Slopes are 5 to 15 percent. This complex is about 55 percent Crespin stony clay and about 35 percent Carlstrom stony clay. The soils have profiles similar to those described as representative of their respective series, but the surface layer has a 15 to 80 percent cover of rounded volcanic rocks as large as 3 feet in diameter.

Included with this complex in mapping are about 10 percent Crespin-Carlstrom clays and Sudduth soils. Also included are small areas of soils that have stone cover several feet thick, and small fill areas where stones are incorporated throughout the soil.

Runoff is rapid. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

The soils in this complex are mostly used for grazing. Capability unit VIIs–1, nonirrigated; Mountain Shale range site.

Cryaquents

Ct—Cryaquents. Cryaquents are stratified, coarse textured to fine textured, recent alluvial soils. They are on low flood plains of the larger streams between elevations of 7,900 and 9,000 feet. These flood plains are on both sides of the streams and merge gradually into slightly higher bottom lands. Slopes are 0 to 2 percent. The surface is generally uneven. Water channels are evident. The native vegetation is tufted hairgrass and water-loving plants such as sedges, rushes, and willows.

The surface layer is moderately dark to dark in color and moderately high in organic matter. Coarse textured material is at a depth of 1 to 6 feet. Gray mottles, which reflect poor drainage, are present in the profile in most places. In most areas, the soils are free of salts and alkali, but a few small areas of salt- or alkali-affected soils are included in mapping.

These soils are flooded in most years. The water table fluctuates between depths of 0 to 2 feet when the soils are not flooded. The floodwaters carry very little sediment. After the water recedes, the only evidence of flooding is a few pieces of driftwood, small bunches of grass hay caught by willows, and thin deposits of sand among the clumps of grass.

These soils are not suited to hay. Capability unit VIIw–1, nonirrigated; Mountain Meadow range site.

Cryorthents, steep

CyF—Cryorthents, steep. Cryorthents includes a variety of shallow soils that differ in depth, color, texture, reaction, and mineralogy. They are on steep terrace breaks and upland ridges between elevations of 7,980 and 9,200 feet. Slopes are 15 to 70 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, Indian ricegrass, winterfat, low rabbitbrush, and fringed sage.

These soils are generally less than 20 inches deep over soft shale or sandstone and have little or no hori-

zon development. In some of the areas mapped as Cryorthents, steep, the soils are deep and cobble-filled or have various depths of cobbly material over shale. In some areas on terraces, side slopes, and breaks, the cobbly overburden is deeper at the upper part of the slope.

Available water capacity is generally low. These soils are on unfavorable exposures, and much of the moisture is removed by strong winds. Runoff is rapid. The hazards of soil blowing and water erosion are severe.

These soils are used for limited grazing. Capability unit VIIs–2, nonirrigated; Dry Exposure range site.

Dobrow series

The Dobrow series consists of deep, poorly drained soils that formed in noncalcareous alluvium. The soils are underlain by sand and gravel at a depth of 20 to 40 inches. They are on low terraces and flood plains between elevations of 8,000 and 9,200 feet. Slopes are 0 to 2 percent. The native vegetation is mainly tufted hairgrass, Nebraska sedge, ovalhead sedge, Baltic rush, slender wheatgrass, cow parsnip, silver sagebrush, and willows. The mean annual precipitation is 10 to 18 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 25 to 35 days.

In a representative profile the surface layer is about 28 inches thick. The upper part is dark grayish brown loam, the middle part is dark gray sandy loam, and the lower part is gray fine sandy loam. The underlying material is light brownish gray very gravelly sand.

Permeability is moderately rapid above the water table, and available water capacity is moderate. The water table is at or near the surface most of the year.

These soils are used mainly for irrigated hay and pasture.

Representative profile of Dobrow loam in native grass, near center of sec. 5, T. 9 N., R. 79 W.:

O1—3 to 2 inches; grass remains, roots, and leaves.

O2—2 inches to 0; partially decomposed organic material similar to that of horizon above.

A11g—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; common medium distinct mottles, dark reddish brown (5YR 3/4) and yellowish brown (10YR 5/8) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; many coarse and medium roots; mildly alkaline; clear smooth boundary.

A12g—4 to 10 inches; dark gray (10YR 4/1) sandy loam, very dark gray (10YR 3/1) moist; common medium prominent mottles, dark reddish brown (5YR 3/4) and yellowish brown (10YR 5/8) moist; weak coarse subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; clear smooth boundary.

A13g—10 to 28 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; common medium prominent mottles, dark reddish brown (5YR 3/4) and yellowish brown (10YR 5/8) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few medium roots; neutral; clear smooth boundary.

IICg—28 to 60 inches; light brownish gray (10YR 6/2) very gravelly sand, grayish brown (10YR 5/2) moist; common medium distinct mottles, dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/8) moist; single grained; loose; 60 percent gravel; neutral.

The profile is slightly acid to mildly alkaline. Mottles range from common and distinct to many and prominent. The profile above the IIC horizon is mostly uniform in texture and has only minor stratification. The IICg horizon is at a depth of 26 to 40 inches.

Do—Dobrow loam. This soil is on low terraces and flood plains along streams and rivers throughout the survey area. Slopes are 0 to 2 percent.

Included with this soil in mapping are a few small narrow gravel bars, small narrow areas of soils that are deeper over sand and gravel, a few small areas of alkali soils. Also included are small areas of Fleer loam in filled oxbow channels.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is irrigated and used for growing grass hay and pasture. A small acreage is used for grazing. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Most areas are flooded in spring for 2 to 3 weeks. Capability units VIw–1, nonirrigated, and VIw–3, irrigated; Mountain Meadow range site.

Dune land

Du—Dune land. This land type consists principally of sand dunes (fig. 3). The dunes consist of windblown sand weathered from Tertiary sandstone. The low ridges and rounded hills are nonbedded. The eastern sand dune area is between elevations of 8,200 and 8,600 feet, and the northern area is between elevations of 8,500 and 8,700 feet.

The hazard of soil blowing is severe, and the hazard of water erosion is slight.

The drifting dunes are not stabilized and are therefore nearly barren of vegetation other than a few scattered plants of thickspike wheatgrass. This land type is used only for recreation. Capability unit VIIIe–1, nonirrigated; not placed in a range site.

Eachuston series

The Eachuston series consists of deep, poorly drained soils that formed in noncalcareous alluvium. They are on low terraces and flood plains between elevations of 8,000 and 9,200 feet. Slopes are 1 to 5 percent. The native vegetation is mainly tufted hairgrass, Nebraska sedge, ovalhead sedge, Baltic rush, herbaceous cinquefoil, and willows. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 35° to 37° F, and the frost-free season is 35 to 40 days.

In a representative profile the surface layer is dark grayish brown and grayish brown gravelly loam about 8 inches thick. The underlying material is grayish brown very gravelly loamy sand.

Permeability is rapid, and the available water capacity is low. The water table is at or near the surface most of the year.

These soils are used mainly for irrigated hay and pasture. Some areas are not irrigated and are used for grazing.

Representative profile of Eachuston gravelly loam in native grass, four-tenths mile northwest of the southeast corner of sec. 20, T. 7 N., R. 77 W.:

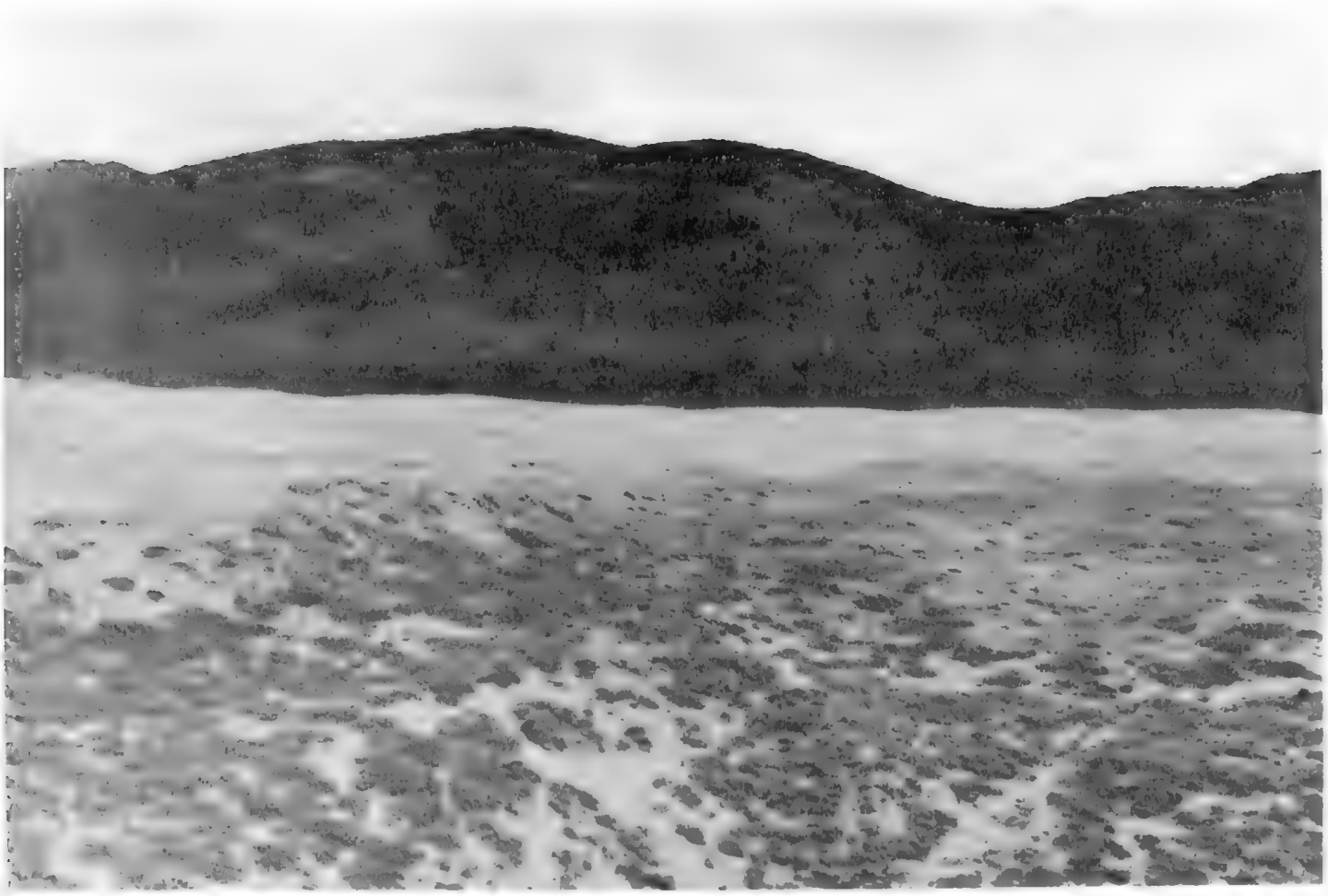

Figure 3.—**Dune land: active sand dunes below steep mountains.**

O1—3 inches to 0; undecomposed organic material, principally grass remains, roots, and leaves.
A1—0 to 4 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable; many fine to coarse roots; 30 percent gravel; neutral; clear smooth boundary.
AC—4 to 8 inches; grayish brown (10YR 5/2) gravelly loam, dark grayish brown (10YR 4/2) moist; common medium distinct mottles, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure parting to fine granular; soft, very friable; many fine roots; 30 percent gravel; neutral; clear wavy boundary.
IIC—8 to 60 inches; grayish brown (10YR 5/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; common medium distinct reddish brown (5YR 4/4) mottles; 60 percent gravel and some cobbles.

Mottles range from common and distinct to many, large, and prominent. Reaction ranges from slightly acid to mildly alkaline.

Ea—Eachuston gravelly loam. This soil is on low terraces and flood plains of streams and rivers throughout the survey area. Slopes are 1 to 5 percent.

Included with this soil in mapping are a few small narrow gravel bars and small, slightly higher areas of Blackwell loam.

Runoff is slow. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage of this soil is irrigated and is used for growing hay and pasture. An organic mat 1 to 4 inches thick generally has formed on the surface. Most areas are flooded in the spring for several weeks. Capability unit VIw–4, irrigated; not placed in a range site.

Ethelman series

The Ethelman series consists of moderately deep, well drained soils that formed in material weathered from North Park Sandstone. The soils are underlain by weathered sandstone at a depth of 20 to 40 inches. They are on rolling uplands between elevations of 7,900 and 8,500 feet. Slopes are 0 to 25 percent. The native vegetation is mainly sheep fescue, pine needlegrass, muttongrass, streambank wheatgrass, junegrass, low rabbitbrush, and big sagebrush. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is dark

grayish brown and grayish brown sandy loam about 7 inches thick. The subsoil is brown and pale brown fine sandy loam about 13 inches thick. The underlying material is light gray light fine sandy loam; lime has accumulated in the lower part. Weathered sandstone is at a depth of about 29 inches.

Permeability is moderately rapid, and the available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Ethelman sandy loam, 0 to 25 percent slopes, in native grass, 380 feet west and 600 feet south of the northeast corner of sec. 10, T. 11 N., R. 80 W.:

A1—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; clear smooth boundary.

A3—4 to 7 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; gradual smooth boundary.

B2t—7 to 16 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to medium subangular blocky; hard, friable, nonsticky and slightly plastic; few fine roots; thin patchy clay films on peds, in some pores, and as clay bridges between some sand grains; neutral; gradual smooth boundary.

B3—16 to 20 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure parting to medium subangular blocky; hard, friable, nonsticky and slightly plastic; few thin patchy clay films on peds and in pores; mildly alkaline; clear wavy boundary.

Cca—20 to 29 inches; light gray (2.5Y 7/2) light fine sandy loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

Cr—29 to 40 inches; soft calcareous sandstone.

The profile is 0 to 20 percent, by volume, coarse fragments ¼ inch to 3 inches in diameter. It contains some cobbles and a few stones in some places. The A horizon is neutral or mildly alkaline. The B2t horizon is neutral to moderately alkaline. The calcareous Cca horizon is at a depth of 16 to 40 inches. The calcium carbonate equivalent of the Cca horizon ranges from 3 to 10 percent. The C horizon is moderately alkaline or strongly alkaline.

EhE—Ethelman sandy loam, 0 to 25 percent slopes. This soil is on rolling uplands in the northwestern part of the survey area.

Included with this soil in mapping are a few small areas of soils that are similar to Ethelman soils but that are less than 20 inches deep over bedrock. In concave areas that are protected from wind, small areas of Owen Creek and Tiagos soils are also included.

Runoff is medium. The hazard of soil blowing is severe, and the hazard of water erosion is moderate.

Most of the acreage of this soil is used for grazing. Capability units VIe–5, nonirrigated, and VIe–10, irrigated; Dry Mountain Loam range site.

Fleer series

The Fleer series consists of deep, poorly drained soils that formed in calcareous alluvium. The soils are underlain by very gravelly loamy sand or sand at a depth of 20 to 40 inches. They are on low terraces and flood plains between elevations of 7,800 and 9,000 feet. Slopes are 0 to 5 percent. The native vegetation is mainly tufted hairgrass, Nebraska sedge, ovalhead sedge, Baltic rush, cow parsnip, silver sagebrush, and willows. The mean annual precipitation is 10 to 15 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile the upper part of the surface layer is gray loam about 11 inches thick, and the lower part is gray fine sandy loam about 19 inches thick. The underlying material is very gravelly loamy sand or sand.

Permeability is moderate, and available water capacity is moderate. The water table is above a depth of 1 foot during most of the growing season.

These soils are used mainly for irrigated hay and pasture. Some areas are used for nonirrigated pasture.

Representative profile of Fleer loam in native grass, one-eighth mile north of the south quarter-corner of sec. 34, T. 9 N., R. 79 W.:

O1—2 inches to 0; undecomposed organic material, mainly grass roots.

A11—0 to 11 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many coarse, medium, and fine roots; strongly calcareous; moderately alkaline; clear smooth boundary.

A12g—11 to 30 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; common medium prominent mottles, dark reddish brown (5YR 3/4) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; strongly calcareous; moderately alkaline; gradual wavy boundary.

IICg—30 to 60 inches; very gravelly loamy sand or sand; many large prominent dark reddish brown (5YR 3/4) moist mottles; strongly calcareous; moderately alkaline.

The profile is mildly alkaline to strongly alkaline. Depth to uniformly calcareous material ranges from 0 to 10 inches. The dark colored A horizon ranges from 21 to 40 inches in thickness. There is a B2 horizon in some places. The profile above the IICg horizon is 5 to 15 percent coarse fragments.

Fe—Fleer loam. This soil is on low terraces and flood plains along major streams and rivers throughout the survey area (fig. 4). The slopes are 0 to 5 percent.

Included with this soil in mapping are a few small areas of alkali soils and areas of soils that are less than 20 inches deep over sand and gravel.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is irrigated and is used for grass hay and pasture. A small acreage of this soil is not irrigated and is used for grazing. An organic mat 1 to 4 inches thick has generally formed on the surface. Most areas are flooded in the spring for several weeks. Capability units VIw–1, nonirrigated, and VIw–3, irrigated; Mountain Meadow range site.

Fluetsch series

The Fluetsch series consists of deep, well drained soils that formed in calcareous alluvium from sandstone and sandy shale. They are on old alluvial fans, old high terraces, and valley sides between elevations of 8,000 and 9,000 feet. Slopes are 2 to 15 percent. The native vegetation is mainly pine needlegrass, june-

Figure 4.—**Area of Fleer loam during spring runoff; old oxbow channels fill with floodwater from river.**

grass, muttongrass, streambank wheatgrass, bluebunch wheatgrass, low rabbitbrush, and big sagebrush. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 36° to 39° F, and the frost-free season is 30 to 40 days.

In a representative profile, the surface layer is pale brown sandy loam about 6 inches thick. The upper part of the subsoil is brown heavy sandy loam about 4 inches thick, and the lower part is light olive brown sandy clay loam about 20 inches thick. The underlying material is light yellowish brown sandy loam.

Permeability is moderate, and the available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Fluetsch sandy loam in an area of Fluetsch-Tiagos association in native grass, near center of NE¼NW¼ sec. 14, T. 9 N., R. 79 W.:

A1—0 to 6 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 5 percent gravel; neutral; clear smooth boundary.

B1—6 to 10 inches; brown (10YR 5/3) heavy sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to medium granular; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots; 5 percent gravel; a few thin patchy clay films on peds; neutral; clear smooth boundary.

B2t—10 to 26 inches; light olive brown (2.5Y 5/4) sandy clay loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; few medium and many fine roots; 5 percent gravel; thin patchy clay films on peds, in pores, and on coarse fragments; mildly alkaline; gradual wavy boundary.

B3ca—26 to 30 inches; light olive brown (2.5Y 5/4) light sandy clay loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure parting to medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; few fine roots; 5 percent gravel; few thin patchy clay films on peds; secondary calcium carbonate as nodules, seams, and coatings on gravel; slightly calcareous; moderately alkaline; gradual wavy boundary.

Cca—30 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 5 percent gravel; secondary calcium carbonate as concretions, thin seams, streaks, and coatings on gravel; strongly calcareous; moderately alkaline.

The profile is 5 to 20 percent, by volume, coarse fragments. Depth to uniformly calcareous material ranges from 15 to 30 inches. The A horizon is neutral or mildly alkaline. The B2t horizon is neutral to moderately alkaline. The calcium carbonate equivalent of the Cca horizon ranges from about 3 percent to 10 percent. The C horizon is moderately alkaline or strongly alkaline.

Fh—Fluetsch-Tiagos association. This association is on old alluvial fans, outwash terraces, and valley sides. Slopes are 2 to 20 percent. The association is about 45 percent Fluetsch sandy loam that has slopes of 2 to 15 percent and about 45 percent Tiagos fine sandy loam that has slopes of 2 to 20 percent. The proportion of each soil varies slightly from place to place. Fluetsch sandy loam has convex, more gentle slopes. The Tiagos sandy loam is on side slopes and in protected areas. Both soils have the profiles described as representative of their respective series.

Included with this association in mapping are a few small areas of Tealson soils in saddles of ridges, Bosler soils in small, mesalike areas, and shallow Cryorthents on exposed ridges and mounds of sandstone. These inclusions make up about 10 percent of this association. Cryorthents, steep, makes up about 5 to 20 percent of the association.

Runoff is medium on the Fluetsch soil and slow on the Tiagos soil. The hazard of soil blowing is slight on the Fluetsch soil and moderate on the Tiagos soil. The hazard of water erosion is moderate.

The association is used mostly for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–9, irrigated; Fluetsch part in Valley Bench range site, and Tiagos part in Dry Mountain Loam range site.

Forelle series

The Forelle series consists of deep, well drained soils that formed in locally transported alluvium. They are on alluvial fans and valley sides between elevations of 7,900 and 8,400 feet. Slopes are 1 to 5 percent. The native vegetation is mainly sheep fescue, pine needlegrass, muttongrass, streambank wheatgrass, junegrass, low rabbitbrush, and big sagebrush. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is light brownish gray loam about 4 inches thick. The upper 3 inches of the subsoil is brown light clay loam, the middle 13 inches is light olive brown clay loam, and the lower 4 inches is pale brown gravelly clay loam in which lime has accumulated. The upper part of the underlying material is pale yellow gravelly clay loam in which lime has accumulated, and the lower part is pale brown gravelly sandy clay loam.

Permeability is moderate, and the available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Forelle loam in native grass, one-eighth mile south of center of sec. 12, T. 7 N., R. 81 W.:

A1—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 1 to 3 percent gravel; neutral; clear smooth boundary.

B1—4 to 7 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak medium granular; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; thin patchy clay films on peds; neutral; clear smooth boundary.

B2t—7 to 20 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and plastic; few fine roots; thin nearly continuous clay films on peds; neutral; gradual smooth boundary.

B3ca—20 to 24 inches; pale brown (10YR 6/3) gravelly clay loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; thin patchy clay films on some peds; few fine lime concretions; moderately calcareous; moderately alkaline; gradual wavy boundary.

Cca—24 to 31 inches; pale yellow (2.5Y 7/4) gravelly clay loam, light olive brown (2.5Y 5/4) moist; weak coarse subangular blocky structure; hard, friable, nonsticky and nonplastic; medium lime concretions; moderately alkaline; gradual wavy boundary.

C2—31 to 60 inches; pale brown (10YR 6/3) gravelly sandy clay loam, brown (10YR 5/3) moist; massive; hard, very friable; strongly calcareous; many lime concretions; moderately alkaline.

The profile contains 0 to 20 percent coarse fragments. The A1 horizon is fine sandy loam or loam. The A horizon is neutral or mildly alkaline. The B2t horizon is clay or silty clay loam. It is neutral to strongly alkaline. Depth to calcareous material ranges from 15 to 30 inches. The C horizon is moderately alkaline or strongly alkaline.

Fo—Forelle loam. This soil is on alluvial fans and valley sides. Slopes are 1 to 5 percent.

Included with this soil in mapping in slightly lower, protected areas are a few small areas of Forelle soils that have a thin, dark surface layer. Also included are small areas of Fluetsch and Cabin soils in higher, benchlike areas.

Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–9, irrigated; Dry Mountain Loam range site.

Gelkie series

The Gelkie series consists of deep, well drained soils that formed in old alluvium from reworked glacial till and in glacial outwash. They are on high terraces, benches, and outwash plains between elevations of 8,200 and 8,800 feet. Slopes are 2 to 15 percent. The native vegetation is mainly Idaho fescue, wheatgrasses, Sandberg bluegrass, needlegrasses, native brome, junegrass, bitterbrush, and big sagebrush. The mean annual precipitation is 16 to 18 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is dark grayish brown sandy loam about 5 inches thick. The upper 8 inches of the subsoil is brown light sandy clay loam, the middle 19 inches is brown and yellowish brown sandy clay loam, and the lower part is light

yellowish brown light sandy clay loam. The underlying material is light yellowish brown heavy sandy loam.

Permeability is moderate, and available water capacity is moderate.

These soils are used mainly for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Gelkie sandy loam, 2 to 15 percent slopes, in native grass, 50 feet south and 800 feet east of the west quarter-corner of sec. 9, T. 6 N., R. 78 W.:

A1—0 to 5 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; moderate fine crumb structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; mildly alkaline; clear wavy boundary.

B1—5 to 13 inches; brown (10YR 5/3) light sandy clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 5 percent gravel; few thin patchy clay films on peds; moderate amount of bleached sand grains; mildly alkaline; clear wavy boundary.

B21t—13 to 19 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very friable, sticky and plastic; many medium and few fine roots; 10 percent gravel; many thin nearly continuous clay films on peds; mildly alkaline; gradual wavy boundary.

B22t—19 to 32 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very friable, sticky and plastic; thin nearly continuous clay films on peds; few medium roots; 10 percent gravel; mildly alkaline; gradual wavy boundary.

B3—32 to 37 inches; yellowish brown (10YR 5/4) light sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; 10 percent gravel; few thin patchy clay films on peds; mildly alkaline; clear wavy boundary.

Cca—37 to 60 inches; light yellowish brown (10YR 6/4) heavy sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and nonplastic; 10 percent gravel; concretions, thin seams and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline.

The profile is 0 to 15 percent coarse fragments throughout. Depth to calcareous material is 10 to 30 inches. The dark colored A horizon is 4 to 16 inches thick. The A1 horizon is sandy loam, fine sandy loam, or light loam. The A and B2t horizons are neutral or mildly alkaline. The Cca horizon is moderately alkaline or strongly alkaline.

GeD—Gelkie sandy loam, 2 to 15 percent slopes. This soil is on high terraces, benches, and outwash plains.

Included with this soil in mapping in narrow bands adjacent to forested areas are a few small areas of soils that are similar to Gelkie soils but that have a light-colored, bleached subsurface layer. Also included are small areas of Cabin sandy loam on the outer edge of benches and in narrow bands.

Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–9, irrigated; Mountain Loam range site.

Gelkie variant

The Gelkie variant consists of moderately deep, well drained soils that formed in material weathered from sandstone, mixed with glacial outwash in places. The soils are underlain by hard sandstone at a depth of 20 to 40 inches. They are on mountainsides and upland ridges between elevations of 8,200 and 9,000 feet. Slopes are 0 to 25 percent. The native vegetation is mainly Idaho fescue, big bluegrass, western wheatgrass, nodding brome, buckwheat, sedge, big sagebrush, and low rabbitbrush. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 25 to 35 days.

In a representative profile the surface layer is dark brown sandy loam about 7 inches thick. The upper 3 inches of the subsoil is grayish brown heavy sandy loam, and the lower 15 inches is light yellowish brown sandy clay loam. Hard sandstone is at a depth of about 25 inches.

Permeability is moderate, and the available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Gelkie sandy loam, moderately deep variant, 0 to 25 percent slopes, in native grass, 1,000 feet east and 425 feet north of the south quarter-corner of sec. 30, T. 8 N., R. 77 W.:

A1—0 to 7 inches; dark brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine to coarse roots; 3 percent gravel; slightly acid; clear smooth boundary.

B1—7 to 10 inches; grayish brown (10YR 5/2) heavy sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots; 5 percent gravel; slightly acid; clear smooth boundary.

B2t—10 to 17 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine and medium roots; 8 percent gravel and cobbles; thin patchy clay films on peds, in pores, and as bridging between sand grains; slightly acid; clear smooth boundary.

B3—17 to 25 inches; light yellowish brown (10YR 6/4) gravelly light sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure parting to weak fine subangular blocky; hard, very friable, slightly sticky and nonplastic; clay films as bridging between sand grains and in root channels; few fine roots; 20 percent gravel and cobbles of sandstone; slightly acid, clear wavy boundary.

R—25 inches; hard fractured sandstone.

The profile is 5 to 20 percent coarse fragments. It is slightly acid throughout. The A1 horizon is sandy loam or fine sandy loam. The B2t horizon is heavy sandy loam or sandy clay loam.

GkE—Gelkie sandy loam, moderately deep variant, 0 to 25 percent slopes. This soil is on mountainsides and upland ridges in the southwestern part of the survey area.

Included with this soil in mapping are a few small

Rock outcrops. Also included are areas of very shallow soils, and narrow dikes or small knobs. Also included are small areas of Kather clay loam in concave or slightly depressional areas.

Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage of this soil is used for grazing. Capability unit VIe–4, nonirrigated; Mountain Loam range site.

Girardot series

The Girardot series consists of deep, poorly drained soils that formed in calcareous alluvium. They are on low terraces and flood plains between elevations of 7,820 and 8,800 feet. Slopes are 0 to 3 percent. The native vegetation is mainly tufted hairgrass, Thurber fescue, Nebraska sedge, ovalhead sedge, Baltic rush, willows, and silver sagebrush. The mean annual precipitation is 12 to 16 inches, the mean annual air temperature is 35° to 38° F, and the frost-free season is 30 to 35 days.

In a representative profile the surface layer is gray silty clay loam about 8 inches thick. The subsoil is light brownish gray sandy clay loam about 52 inches thick.

Permeability is moderate, and available water capacity is high.

These soils are used mainly for irrigated hay and pasture. Some areas are not irrigated and are used for grazing.

Representative profile of Girardot silty clay loam in native grass, three-eighths mile north of south quarter-corner of sec. 30, T. 11 N., R. 79 W.:

A1g—0 to 8 inches; gray (2.5Y 6/1) silty clay loam, dark gray (2.5Y 4/1) moist; common medium distinct mottles, reddish brown (5YR 4/4) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; moderately alkaline; gradual wavy boundary.

B2g—8 to 60 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; many medium prominent mottles, reddish brown (5YR 4/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; moderately alkaline.

The profile is generally calcareous throughout, but depth to uniformly calcareous material ranges from 0 to 10 inches. Calcium carbonate equivalent ranges from 3 to 10 percent. Reaction ranges from mildly alkaline to strongly alkaline. The B2g horizon is loam, sandy clay loam, or clay loam.

Gn—Girardot silty clay loam. This soil is on low terraces and flood plains of streams and rivers throughout the survey area. Slopes are 0 to 3 percent.

Included with this soil in mapping are a few small areas of soils that are similar to Girardot soils but that are alkali affected and are 40 to 60 inches deep over sand and gravel.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is irrigated and used for grass hay and pasture. A small acreage of this soil is not irrigated and is used for grazing. An organic mat 1 to 4 inches thick has generally formed on the surface and bright, rust-colored mottles have formed throughout the profile. Capability units VIw–1, nonirrigated, and VIw–2, irrigated; Mountain Meadow range site.

Gothic series

The Gothic series consists of deep, well drained soils that formed in moderately fine textured alluvium and glacial till. They are on side slopes of valley fill and on alluvial fans between elevations of 8,500 and 9,500 feet. Slopes are 0 to 20 percent. The native vegetation is mainly Thurber fescue, Idaho fescue, big bluegrass, American vetch, slender wheatgrass, silver sagebrush, shrubby cinquefoil, and big sagebrush. The mean annual precipitation is 18 to 22 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile the upper part of the surface layer is dark grayish brown loam about 4 inches thick, and the lower part is grayish brown light clay loam about 8 inches thick. The subsoil is clay loam about 33 inches thick; the upper part is yellowish brown, and the lower part is mixed dark gray, light olive brown, and olive. The underlying material is pale olive heavy clay loam.

Permeability is slow, and available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated hay.

Representative profile of Gothic loam, 0 to 20 percent slopes, in native grass, 700 feet south and 160 feet west of the north quarter-corner of sec. 24, T. 7 N., R. 77 W.:

A11—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine crumb structure; soft, very friable, nonsticky and nonplastic; many medium and fine roots; slightly acid; clear smooth boundary.

A12—4 to 12 inches; grayish brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; few bleached white sand grains; slightly acid; gradual wavy boundary.

B21t—12 to 22 inches; yellowish brown (10YR 5/4) heavy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium and fine subangular blocky structure; hard, friable, sticky and plastic; many medium and few fine roots; thin continuous clay films on peds; neutral; gradual wavy boundary.

B22t—22 to 30 inches; mixed dark gray (2.5Y 4/1), light olive brown (2.5Y 5/4), and olive (5Y 5/3) heavy clay loam, very dark gray (2.5Y 3/1), olive brown (2.5Y 4/4), and olive (5Y 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; thin continuous clay films on peds; colors are lithochromic; neutral; gradual wavy boundary.

B3—30 to 45 inches; mixed dark gray (2.5Y 4/1), light olive brown (2.5Y 5/4), and olive (5Y 5/3) clay loam, very dark gray (2.5Y 3/1), olive brown (2.5Y 4/4), and olive (5Y 4/3) moist; weak coarse and medium subangular blocky structure; very hard, firm, sticky and plastic; 5 percent gravel; thin nearly continuous clay films on peds; colors are lithochromic; neutral; gradual wavy boundary.

C—45 to 50 inches; pale olive (5Y 6/3) heavy clay loam, olive (5Y 5/3) moist; many large prominent light olive brown (2.5Y 5/6) mottles; massive; hard, very friable; neutral.

The A1 horizon is loam or light clay loam 8 to 15 inches thick. It is slightly acid to mildly alkaline. The B horizon is heavy clay loam or light clay. The B2t horizon is neutral or mildly alkaline. The C horizon is neutral to moderately alkaline. The profile is calcareous below a depth of 40 inches in some places.

GoE—Gothic loam, 0 to 20 percent slopes. This soil is on valley sides and alluvial fans in the southern and central parts of the survey area.

Included with this soil in mapping are a few small areas of soils that are similar to Gothic soil but that have a light colored A2 horizon ½ inch to 2 inches thick. In about half of the areas mapped, the surface layer is light clay loam.

Runoff is medium or rapid. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–1, nonirrigated, and VIe–8, irrigated; Subalpine Loam range site.

Grafen series

The Grafen series consists of moderately deep, well drained soils that formed in material weathered from sandstone. The soils are underlain by sandstone at a depth of 20 to 40 inches. The soils are on uplifted hills and ridges between elevations of 8,200 and 8,600 feet. Slopes are 15 to 45 percent. The native vegetation is mainly bluebunch wheatgrass, mountain muhly, sheep fescue, pine needlegrass, junegrass, buckwheat, low rabbitbrush, and big sagebrush. The mean annual precipitation is 15 to 18 inches, the mean annual air temperature is 37° to 39° F, and the frost-free season is 30 to 35 days.

In a representative profile (fig. 5) the surface layer is grayish brown extremely stony sandy loam about 10 inches thick. The underlying material is light brownish gray extremely stony sandy loam. Sandstone is at a depth of about 30 inches.

Figure 5.—**Profile of Grafen extremely stony sandy loam.**

Permeability is rapid, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Grafen extremely stony sandy loam in an area of Grafen-Rock outcrop complex in native grass, 1,300 feet north and 500 feet east of southwest corner of sec. 16, T. 10 N., R. 78 W.:

A1—0 to 10 inches; grayish brown (10YR 5/2) extremely stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 35 percent stones; neutral; clear smooth boundary.

C1—10 to 30 inches; light brownish gray (10YR 6/2) extremely stony sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; 70 percent stones; neutral; clear smooth boundary.

C2r—30 to 60 inches; soft noncalcareous sandstone or interbedded siltstone that contains lenses of indurated sandstone.

The profile is 35 to 80 percent coarse fragments, predominantly more than 10 inches in diameter. Reaction ranges from slightly acid to mildly alkaline. The C2r horizon ranges from soft to fractured hard sandstone.

Gr—Grafen-Rock outcrop complex. This complex is made up of moderately deep soils on uplifted hills and ridges. About 50 percent of this complex is Grafen extremely stony sandy loam and about 30 percent is Rock outcrop. Grafen extremely stony sandy loam has slopes of 15 to 45 percent and is on smooth ridges and hillsides. Rock outcrop has slopes of 20 to 60 percent and is on crests of ridges and steeper areas (fig. 6).

Included with this complex in mapping is about 20 percent moderately deep, moderately coarse textured soils that are similar to Grafen soils but that contain less than 35 percent gravel and stones and that have slopes of 6 to 15 percent.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

This complex is used mainly for grazing. Grafen part in capability unit VIIs–1, nonirrigated, and Rock outcrop part in capability unit VIIIs–1, nonirrigated; Grafen part in Rocky Loam range site, and Rock outcrop part not placed in a range site.

Grimstone series

The Grimstone series consists of moderately deep, well drained soils that formed in weathered mica schist. The soils are underlain by mica schist at a depth of 20 to 40 inches. They are on mountainsides between elevations of 8,000 and 9,800 feet. Slopes are 5 to 25 percent. The native vegetation is mainly lodgepole pine and a sparse understory of oregongrape, buffaloberry, kinnikinnick, boxleaf myrtle, sedges, heartleaf arnica, and vaccinium. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 30 to 35 days.

In a representative profile, a layer of organic duff about 2 inches thick is on the surface. The surface layer is grayish brown sandy loam about 2 inches thick. The subsurface layer is light brownish gray

Figure 6.—**Area of Grafen-Rock outcrop complex. Surface of Grafen soils is extremely stony.**

sandy loam about 18 inches thick. The subsoil is yellowish brown clay loam about 7 inches thick. Weathered micaceous schist is at a depth of about 27 inches.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for producing timber.

Representative profile of Grimstone sandy loam in an area of Grimstone-Siebert association, cutover land, 600 feet south and 400 feet east of north quarter-corner of sec. 34, T. 12 N., R. 81 W.:

O1—2 inches to 1 inch; undecomposed organic material, mainly needles, bark, leaves, twigs, and fleshy remains of grasses and shrubs.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.

A1—0 to 2 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; strong fine crumb structure; soft, very friable, nonsticky and nonplastic; many coarse to fine roots; enough mica to give soil mass a soaplike consistence when moist; medium acid; abrupt smooth boundary.

A2—2 to 12 inches; light brownish gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; very weak thick platy structure parting to fine subangular blocky; soft, very friable, nonsticky and nonplastic; many fine and medium roots; enough mica to give soil mass a soaplike consistence when moist; medium acid; gradual wavy boundary.

A&B—12 to 20 inches; mixed light brownish gray (10YR 6/2) and yellowish brown (10YR 5/4) loam, grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure parting to fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; thin patchy clay films on some peds and in pores; enough mica to give soil mass a soaplike consistence when moist; horizon consists of nodules of clayey material similar to that of underlying horizon surrounded by sandy loam material similar to that of overlying horizon; slightly acid; clear wavy boundary.

B2t—20 to 27 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; thin patchy clay films on peds and in pores; 5 percent gravel; enough mica to give soil mass a soaplike consistence when moist; slightly acid; gradual wavy boundary.

Cr—27 to 40 inches; weathered micaceous schist.

The profile is 0 to 35 percent coarse fragments ¼ inch to 10 inches in diameter. The sand- and silt-sized material is 15 to 30 percent mica platelets of sufficient size to affect the physical condition of the soil. Reaction ranges from medium acid to neutral. The thin A1 horizon is absent in some profiles. The B2t horizon is loam or clay loam.

Gs—Grimstone-Siebert association. This association is made up of moderately deep and deep soils on mountainsides in the northwestern part of the survey area. Slopes are 5 to 25 percent. This association is about 65 percent Grimstone sandy loam and about 35 percent Siebert gravelly loamy sand. Siebert gravelly sandy loam is on dikelike areas in some parts of the area.

Included with this association in mapping, on slope breaks and crests of ridges, are a few small areas of Rock outcrop and very shallow soils.

Runoff is medium on the Grimstone soil and slow on the Siebert soil. The hazard of soil blowing is slight on the Grimstone soil and severe on the Siebert soil.

The hazard of water erosion is moderate on the Grimstone soil and slight on the Siebert soil.

This association is in forest. A small acreage is clear-cut and used for grazing. Grimstone part in capability unit VIe–4, nonirrigated, and Siebert part in capability unit VIe–5, nonirrigated; not placed in a range site.

Handran series

The Handran series consists of deep, well drained soils that formed in glacial till. They are on glacial moraines between elevations of 8,500 and 9,200 feet. Slopes are 20 to 40 percent. The native vegetation is mainly Idaho fescue, muttongrass, nodding brome, bluebunch wheatgrass, needleandthread, bitterbrush, serviceberry, low rabbitbrush, and big sagebrush. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 30 to 35 days.

In a representative profile the surface layer is grayish brown extremely stony sandy loam about 10 inches thick. The underlying material is brown and yellowish brown extremely stony coarse sandy loam.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Handran extremely stony sandy loam, 20 to 40 percent slopes, in native grass, 500 feet east and 200 feet north of the southwest quarter-corner of sec. 24, T. 11 N., R. 81 W.:

A1—0 to 10 inches; grayish brown (10YR 5/2) extremely stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 60 percent stones, mostly rounded; neutral; clear smooth boundary.

AC—10 to 14 inches; brown (10YR 5/3) extremely stony coarse sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, very friable, nonsticky and nonplastic; many fine and few medium roots; 40 percent stones; neutral; gradual wavy boundary.

C—14 to 60 inches; yellowish brown (10YR 5/4) extremely stony coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive; very hard, very friable, nonsticky and nonplastic; 45 percent stones; neutral.

The profile is 35 to 80 percent coarse fragments, predominantly more than 10 inches in diameter. It is medium acid to mildly alkaline. The dark colored A1 horizon ranges from 10 to 15 inches in thickness.

HaF—Handran extremely stony sandy loam, 20 to 40 percent slopes. This soil is on glacial moraines in the western part of the survey area.

Included with this soil in mapping are a few small areas of deeper silty soils in depressions and heavier soils on toe slopes.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is used for grazing. Capability unit VIIs–1, nonirrigated; Stony Loam range site.

Hyannis series

The Hyannis series consists of moderately deep, well drained soils that formed in weathered sandstone of the Coalmont Formation. The soils are underlain by soft sandstone at a depth of 20 to 40 inches. They are on mountainsides and upland hills and ridges between elevations of 8,000 and 9,500 feet. Slopes are 5 to 25 percent. The native vegetation is mainly lodgepole pine and a sparse understory of oregongrape, elk sedge, vaccinium, boxleaf myrtle, and kinnikinnick. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile the surface layer is brown fine sandy loam about 3 inches thick. The subsurface layer is very pale brown gravelly loamy sand about 9 inches thick. The subsoil is yellowish brown and very pale brown very cobbly loamy sand that contains lenses of sandy clay loam about 18 inches thick. Soft sandstone is at a depth of about 30 inches.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for producing timber. Some areas are cleared and used for grazing.

Representative profile of Hyannis fine sandy loam in an area of Perceton-Hyannis association, in forest, 180 feet north and 1,230 feet east of west quarter-corner of sec. 15, T. 5 N., R. 78 W.:

O1—2 inches to 1 inch; undecomposed organic material, mainly needles, bark, twigs, and leaves.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.

A1—0 to 3 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; strong fine crumb structure; soft, very friable, nonsticky and nonplastic; many fine roots; 10 percent gravel; medium acid, abrupt smooth boundary.

A2—3 to 12 inches; very pale brown (10YR 8/3) gravelly loamy sand, pale brown (10YR 6/3) moist; weak very thick platy structure; soft, very friable, nonsticky and nonplastic; few fine and medium roots; 15 percent gravel and cobbles; medium acid; gradual wavy boundary.

B2t—12 to 30 inches; mixed yellowish brown (10YR 5/4) and very pale brown (10YR 7/4) very cobbly loamy sand, dark yellowish brown (10YR 4/4) and light yellowish brown (10YR 6/4) moist; lenses and seams of sandy clay loam; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; thin patchy clay films on some peds, in pores and on underside of some coarse fragments; 65 percent cobbles and some gravel; medium acid; gradual wavy boundary.

Cr—30 to 50 inches; soft noncalcareous sandstone that has lenses of partially cemented cobbles.

A thin A1 horizon is present in places. The B2t horizon is 35 to 75 percent coarse fragments. It is medium acid to neutral. The B2t horizon is variable and is made up of a cobbly or very cobbly loamy sand or sand matrix in which there are discontinuous seams of sandy loam, loam, and sandy clay loam.

This soil was mapped only in association with Perceton soils.

Kather series

The Kather series consists of moderately deep, well drained soils that formed in material weathered from shale. The soils are underlain by soft shale at a depth of 20 to 40 inches. They are on uplands and valley sides between elevations of 8,000 and 9,200 feet. Slopes are 5 to 20 percent. The native vegetation is mainly bluebunch wheatgrass, pine needlegrass, muttongrass,

junegrass, western wheatgrass, low rabbitbrush, serviceberry, and big sagebrush. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is light brownish gray clay loam about 4 inches thick. The upper part of the subsoil is pale brown light clay about 3 inches thick, and the lower part is brown clay about 25 inches thick. Shale is at a depth of about 32 inches.

Permeability is slow, and available water capacity is moderate.

These soils are used mainly for grazing. Some areas are irrigated and used for grass hay.

Representative profile of Kather clay loam, 5 to 20 percent slopes, in native grass, 1,180 feet east and 325 feet north of southwest corner of sec. 3, T. 6 N., R. 81 W.:

A1—0 to 4 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; mildly alkaline; clear smooth boundary.

B1—4 to 7 inches; pale brown (10YR 6/3) light clay, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to fine subangular blocky; slightly hard, very friable, sticky and plastic; few fine and medium roots; few thin patchy clay films on peds and in pores; mildly alkaline; clear smooth boundary.

B2t—7 to 28 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate coarse and medium prismatic structure parting to coarse and medium angular blocky; extremely hard, very firm, sticky and plastic; few fine roots; moderate continuous clay films on peds and in pores; mildly alkaline; gradual smooth boundary.

B3—28 to 32 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few thin patchy clay films on peds and in some pores; mildly alkaline; gradual wavy boundary.

Cr—32 to 40 inches; noncalcareous shale.

The profile is generally noncalcareous to a depth of 40 inches or more, but a thin discontinuous calcareous horizon is just above bedrock in some places. Content of coarse fragments ranges from 0 to 15 percent. Reaction ranges from neutral to mildly alkaline. The B2t horizon is heavy clay loam or light clay.

KaE—Kather clay loam, 5 to 20 percent slopes. This soil is on uplands and valley sides throughout the survey area.

Included with this soil in mapping at the eastern edge of the park are a few small areas of soils that are similar to Kather soils but that have a surface layer of sandy loam. Also included are small areas on ridge crests and slope breaks of Crespin and Carlstrom soils.

Runoff is medium and rapid. The hazard of soil blowing is moderate, and the hazard of water erosion is severe.

Most of the acreage of this soil is used for grazing. A small acreage of this soil is irrigated and is used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright rust-colored mottles form throughout the profile. Capability units VIe–1, nonirrigated, and VIe–8, irrigated; Mountain Shale range site.

Larand series

The Larand series consists of deep, well drained soils that formed in coarse textured glacial till. The soils are underlain by very gravelly sand at a depth of 24 to 55 inches. They are on glacial terraces, fans, and moraines between elevations of 8,500 and 10,000 feet. Slopes are 3 to 40 percent. The native vegetation is mainly lodgepole pine, spruce, and fir and a sparse understory of oregongrape, elk sedge, vaccinium, kinnikinnick, and heartleaf arnica. The mean annual precipitation is 18 to 25 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 25 to 30 days.

In a representative profile the surface layer is light gray fine sandy loam about 16 inches thick. The subsoil is light yellowish brown very gravelly sandy clay loam about 16 inches thick. The underlying material is light yellowish brown very gravelly sand.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for producing timber, for wildlife habitat, and for recreation.

Representative profile of Larand fine sandy loam, 3 to 25 percent slopes, in timber, 400 feet east and 400 feet north of center of sec. 3, T. 7 N., R. 77 W.:

O1—2 inches to 1 inch; undecomposed organic material, mostly needles, bark, and twigs.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.

A2—0 to 10 inches; light gray (10YR 7/2) fine sandy loam, pale brown (10YR 6/3) moist; moderate medium platy structure parting to fine granular; soft, very friable, nonsticky and nonplastic; few medium roots; medium acid; gradual wavy boundary.

A&B—10 to 16 inches; mixed light gray (10YR 7/2) and light yellowish brown (10YR 6/4) heavy fine sandy loam, pale brown (10YR 6/3) and yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; few thin patchy clay films on some peds; 5 percent gravel and cobbles; horizon consists of seams and nodules of material similar to that of underlying horizon embedded in light colored matrix similar to that of overlying horizon; slightly acid; diffuse wavy boundary.

B2t—16 to 28 inches; light yellowish brown (10YR 6/4) very gravelly sandy clay loam, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few fine and coarse roots; thin patchy clay films on peds, in pores, on underside of coarse fragments, and as bridges between sand grains; 60 percent gravel and cobbles; slightly acid; diffuse wavy boundary.

B3—28 to 32 inches; light yellowish brown (10YR 6/4) very gravelly light sandy clay loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; a few patchy clay films on peds, on underside of coarse fragments, and as bridges between sand grains; 60 percent gravel and cobbles; slightly acid; diffuse wavy boundary.

IIC—32 to 60 inches; light yellowish brown (10YR 6/4) very gravelly sand, yellowish brown (10YR 5/4) moist; single grained; loose; 70 percent gravel and cobbles; slightly acid.

The profile is 35 to 75 percent coarse fragments ¼ inch to 10 inches in diameter. It is medium acid to mildly alkaline. There is a thin, dark-colored A1 horizon in some places. Depth to the sandy-skeletal IIC horizon ranges from 24 to 55 inches. The IIC horizon is very gravelly or very cobbly loamy sand or sand.

LaE—Larand fine sandy loam, 3 to 25 percent slopes. This soil is on glacial terraces, fans, and moraines in the southern part of the survey area. Slopes range from 3 to 25 percent but are mostly 3 to 15 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small rock streams in slightly higher or steeper areas and small areas of Troutville and Cowdrey soils in low drainageways.

Runoff is medium. The hazards of soil blowing and water erosion are moderate.

Most of the acreage of this soil is in forest. A small acreage is cleared and is used for grazing. Capability unit VIe–4, nonirrigated; not placed in a range site.

LaF—Larand fine sandy loam, 25 to 40 percent slopes. This soil is on glacial moraines and steep areas on fans in the southern part of the survey area.

Included with this soil in mapping are a few small areas of Troutville soils, rock streams adjacent to drainage channels, and a few areas in which rock makes up a large amount of the surface area.

Runoff is medium. The hazard of soil blowing is moderate, and the hazard of water erosion is high.

Most of the acreage of this soil is in forest. Capability unit VIIe–2, nonirrigated; not placed in a range site.

Leavitt series

The Leavitt series consists of deep, well drained soils that formed in glacial outwash and old alluvium. They are on alluvial fans and sides of valleys between elevations of 8,200 and 9,200 feet. Slopes are 2 to 5 percent. The native vegetation is mainly Idaho fescue, wheatgrasses, Sandberg bluegrass, needlegrasses, native brome, junegrass, sedges, squirreltail, and big sage (fig. 7). The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is dark grayish brown loam about 9 inches thick. The upper 4 inches of the subsoil is dark brown loam, the middle 15 inches is brown light clay loam, and the lower 9 inches is light yellowish brown light clay loam in which lime has accumulated. The underlying material is light yellowish brown loam.

Permeability is moderate, and available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Leavitt loam in native grass, center of sec. 3, T. 7 N., R. 78 W.:

A1—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak thick platy structure parting to moderate medium crumb; soft, very friable, slightly sticky and nonplastic; many fine roots; neutral; clear smooth boundary.

B1—9 to 13 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and nonplastic; many fine and medium roots; thin patchy clay films on peds and in pores; 5 percent gravel; neutral; clear smooth boundary.

B2t—13 to 28 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky and plastic; few fine roots; thin nearly continuous clay films on peds; 5 percent fine gravel; neutral; gradual wavy boundary.

Figure 7.—**Area of Leavitt loam.**

B3ca—28 to 37 inches; light yellowish brown (10YR 6/4) light clay loam, brown (10YR 5/4) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; very few fine roots; thin patchy clay films on peds and in pores; 5 percent fine gravel; small concretions of calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

Cca—37 to 60 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 5/4) moist; massive; hard, friable, nonsticky and nonplastic; 5 percent gravel; large weak concretions of calcium; strongly calcareous; moderately alkaline.

The profile is 0 to 15 percent coarse fragments throughout. The A horizon ranges from heavy sandy loam to loam. There is a light-colored A2 horizon 1 to 3 inches thick between the A1 and B2t horizons in many areas adjacent to forest. The B2t horizon is heavy loam or clay loam. The A, B1, and B2t horizons are slightly acid to mildly alkaline. The calcium carbonate content of the Cca horizon ranges from 6 to 10 percent. The B3ca and Cca horizons are moderately alkaline or strongly alkaline.

Le—Leavitt loam. This soil is on alluvial fans and valley sides. Slopes are 2 to 5 percent.

Included with this soil in mapping are a few small areas of Leavitt soils that have slopes of as much as 10 percent. Also included are small, low, ridgelike areas of Morset and Cabin soils.

Runoff is medium. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–9, irrigated; Mountain Loam range site.

Lulude series

The Lulude series consists of moderately deep, well drained soils that formed in material weathered from basalt flows. The soils are underlain by hard basalt bedrock at a depth of 20 to 40 inches. They are on mountainsides between elevations of 9,000 and 9,800 feet. Slopes are 10 to 25 percent. The native vegetation is mainly lodgepole pine, spruce, and fir and a sparse understory of oregongrape, elk sedge, vaccinium, kinnikinnick, and lupine. The mean annual precipitation is 20 to 24 inches, the mean annual air temperature is 33° to 35° F, and the frost-free season is 25 to 30 days.

In a representative profile the surface layer is brown cobbly loam about 3 inches thick. The subsurface layer is pale brown and brown cobbly loam about 19 inches thick. The subsoil is brown cobbly clay loam about 8 inches thick. Hard basalt is at a depth of about 30 inches.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for producing timber, for wildlife habitat, and for recreation.

Representative profile of Lulude cobbly loam, 10 to 25 percent slopes, in forest in unsurveyed section of Colorado State Forest approximately one-half mile east of Camp Pennock and 900 feet north on trail road, approximately SE¼ sec. 23, T. 7 N., R. 77 W.:

O1—3 to 2 inches; undecomposed organic material, principally needles, bark, twigs, and leaves.

O2—2 inches to 0; partially decomposed organic material similar to that of horizon above.

A1—0 to 3 inches; brown (10YR 5/3) cobbly loam, dark brown (10YR 3/3) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; 20 percent cobbles and some gravel; medium acid; clear smooth boundary.

A2—3 to 14 inches; pale brown (10YR 6/3) cobbly loam, brown (10YR 5/3) moist; weak medium platy structure parting to fine granular; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; 35 percent cobbles and some gravel; slightly acid; gradual wavy boundary.

A&B—14 to 22 inches; mixed pale brown (10YR 6/3) and brown (10YR 5/3) cobbly heavy loam, brown (10YR 5/3) and dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; thin nearly continuous clay films on some peds and in some pores; 40 percent cobbles and some gravel; slightly acid; gradual wavy boundary.

B2t—22 to 30 inches; brown (10YR 5/3) cobbly clay loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; nearly continuous clay films on peds, in pores, and on most coarse fragments; few fine roots; distinct light-colored skeletan coatings on peds; 45 percent cobbles and some gravel; slightly acid; abrupt wavy boundary.

R—30 inches; basalt.

The profile is 20 to 80 percent coarse fragments, predominantly ¼ inch to 10 inches in diameter. Reaction ranges from medium acid to neutral. The thin A1 horizon is not present in places. The B2t horizon is cobbly or very cobbly loam, clay loam, or sandy clay loam.

LuE—Lulude cobbly loam, 10 to 25 percent slopes. This soil is on mountainsides and ridges that have formed from volcanic flows in the southeastern part of the survey area.

Included with this soil in mapping are a few small areas of Rock outcrop and very shallow soils on narrow ridges and mounds adjacent to spouts or terminal volcanic flow patterns.

Runoff is medium or rapid. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage of this soil is in forest. Capability unit VIIs–1, nonirrigated; not placed in range site.

Lymanson series

The Lymanson series consists of moderately deep, well drained soils that formed in material that weathered from shale and is mixed with cobbles and stones from Rock outcrops upslope. The soils are underlain by calcareous shale at a depth of 20 to 40 inches. They are on uplands and mountainsides between elevations of 8,000 and 9,000 feet. Slopes are 4 to 10 percent. The native vegetation is mainly bluebunch wheatgrass, mountain muhly, needleandthread, sheep fescue, pine needlegrass, low rabbitbrush, and big sagebrush. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 35° to 37° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is dark grayish brown cobbly loam about 5 inches thick. The

upper 4 inches of the subsoil is brown cobbly loam, the middle 11 inches is brown cobbly light clay loam, and the lower 5 inches is yellowish brown cobbly light clay loam in which lime has accumulated. The underlying material is light yellowish brown cobbly light clay loam. Soft, calcareous siltstone and shale are at a depth of about 30 inches.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Lymanson cobbly loam, 4 to 10 percent slopes, in native grass, center of NW¼ sec. 3, T. 8 N., R. 81 W.:

A1—0 to 5 inches; dark grayish brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; moderate fine crumb structure; soft, very friable, nonsticky and slightly plastic; many medium and fine roots; 30 percent cobbles; neutral; clear smooth boundary.

B1—5 to 9 inches; brown (10YR 5/3) cobbly loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine and few medium roots; few thin patchy clay films on some peds; 25 percent cobbles; neutral; clear smooth boundary.

B2t—9 to 20 inches; brown (10YR 5/3) cobbly light clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, friable, sticky and slightly plastic; few medium roots; thin nearly continuous clay films on peds; 25 percent cobbles; mildly alkaline; clear wavy boundary.

B3ca—20 to 25 inches; yellowish brown (10YR 5/4) cobbly light clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; extremely hard, friable, sticky and plastic; thin patchy clay films on peds and in some pores; 25 percent cobbles; concretions and thin seams of secondary calcium carbonate; strongly calcareous; moderately alkaline; diffuse wavy boundary.

C1ca—25 to 30 inches; light yellowish brown (10YR 6/4) cobbly light clay loam, yellowish brown (10YR 5/4) moist; massive; very hard, firm, slightly sticky and plastic; 30 percent cobbles; concretions, thin seams, and streaks of secondary carbonate; strongly calcareous; moderately alkaline; diffuse wavy boundary.

C2r—30 to 60 inches; interbedded soft shale, siltstone, and sandstone; calcareous.

The profile is 15 to 35 percent coarse fragments, predominantly ½ inch to 10 inches in diameter. The A horizon is sandy loam or cobbly loam. The B2t horizon is gravelly or cobbly loam or gravelly or cobbly clay loam. Depth to calcareous material ranges from 10 to 20 inches. The A and B horizons are neutral to moderately alkaline. The C horizon is moderately alkaline.

As mapped in Jackson County Area, these soils have a slightly thicker solum than is defined for the Lymanson series. This difference does not affect use, management, or behavior of the soils.

LyD—Lymanson cobbly loam, 4 to 10 percent slopes. This soil is on uplands and mountainsides in the west-central part of the survey area.

Included with this soil in mapping on slope breaks are a few small areas of soils that are similar to Lymanson soils but that are less than 20 inches deep and that have weakly developed subsoil and horizon of lime accumulation. Also included are small areas of Crespin clay that has slopes of more than 10 percent. In places as much as 30 percent of the surface is covered by coarse material that ranges from gravel to boulder in size.

Runoff is slow. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is used for grazing. Capability unit VIe–4, nonirrigated; Rocky Loam range site.

MacFarlane series

The MacFarlane series consists of deep, well drained soils that formed in coarse textured glacial till. They are on terminal and lateral moraines on mountainsides between elevations of 8,500 and 9,800 feet. Slopes are 25 to 60 percent. The native vegetation is mainly lodgepole pine, Englemann spruce, and subalpine fir and a sparse to moderate understory of oregongrape, elk sedge, vaccinium, boxleaf myrtle, and strawberry. The mean annual precipitation is 18 to 24 inches, the mean annual air temperature is 30° to 34° F, and the frost-free season is 20 to 30 days.

In a representative profile the surface layer is dark grayish brown extremely stony loam about 2 inches thick. The subsurface layer is very pale brown very stony sandy loam about 16 inches thick. The subsoil is yellowish brown extremely stony sandy loam about 22 inches thick. The underlying material is pale brown extremely stony sandy loam.

Permeability is moderately rapid, and available water capacity is low.

These soils are used mainly for producing timber and for recreation.

Representative profile of MacFarlane extremely stony loam in an area of MacFarlane-Rock outcrop association, in forest, in approximately the SW¼SE¼ sec. 5, T. 7 N., R. 76 W.:

O1—4 inches to 1 inch; undecomposed organic material, principally bark, twigs, and needles.

O2—1 inch to 0; decomposed organic material similar to that of horizon above.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) extremely stony loam, very dark brown (10YR 2/2) moist; strong fine crumb structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 40 percent stones; neutral; clear smooth boundary.

A2—2 to 12 inches; very pale brown (10YR 7/3) very stony sandy loam, brown (10YR 5/3) moist; weak medium platy structure parting to fine granular; soft, very friable, nonsticky and nonplastic; few medium roots; 25 percent stones; neutral; gradual wavy boundary.

A&B—12 to 18 inches; mixed very pale brown (10YR 7/3) and yellowish brown (10YR 5/4) very stony sandy loam, brown (10YR 5/3) and dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; few medium and fine roots; few thin patchy clay films on some peds; 25 percent stones; horizon consists of seams and nodules of material similar to that of underlying horizon embedded in light colored matrix similar to that of overlying horizon; neutral; gradual wavy boundary.

B2t—18 to 36 inches; yellowish brown (10YR 5/4) extremely stony sandy loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; thin patchy clay films on peds, on sand grains, as bridges

between sand grains, and in pores; 60 percent stones; neutral; gradual wavy boundary.

B3—36 to 40 inches; yellowish brown (10YR 5/4) extremely stony sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few patchy clay films on rock fragments and as bridges between sand grains; 60 percent stones; neutral; diffuse wavy boundary.

C—40 to 60 inches; pale brown (10YR 6/3) extremely stony sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 65 percent stones; neutral.

The profile is 35 to 80 percent rock fragments, mainly 10 to 24 inches in diameter. Reaction ranges from medium acid to mildly alkaline.

Ma—MacFarlane-Rock outcrop association. This association is on terminal and lateral glacial moraines in the eastern part of the survey area. This association is about 60 percent MacFarlane extremely stony loam and about 20 percent Rock outcrop. The MacFarlane soil has slopes of 25 to 60 percent, and Rock outcrop has slopes of 40 to 80 percent. Rock outcrop is in steeper areas and on ridge crests.

Included in mapping are areas of very shallow soils; long, narrow, north-facing areas of steep Pinkham soils; and a few small areas of poorly drained soils along narrow drainageways. These included soils make up about 20 percent of the area mapped as this association.

Runoff is slow on the MacFarlane part and rapid on Rock outcrop. On the MacFarlane part, the hazard of soil blowing is slight and the hazard of water erosion is moderate.

This association is in forest and is used for producing timber and for recreation. MacFarlane part in capability unit VIIs–1, nonirrigated, and Rock outcrop part in capability unit VIIIs–1, nonirrigated; not placed in a range site.

Manburn series

The Manburn series consists of shallow, well drained soils that formed in weathered cemented boulder conglomerate and stratified sandstone. The soils are underlain by siltstone and sandstone at a depth of 10 to 20 inches. They are on upland ridges and mountainsides between elevations of 8,000 and 9,500 feet (fig. 8). Slopes are 10 to 40 percent. The native vegetation is mainly bluebunch wheatgrass, pine needlegrass, needle-

Figure 8.—**Manburn soils in a steep, wind blown area.**

andthread, Indian ricegrass, streambank wheatgrass, low rabbitbrush, low phlox, and winterfat. The mean annual precipitation is 15 to 18 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 25 to 30 days.

In a representative profile the surface layer is grayish brown gravelly coarse sandy loam about 4 inches thick. The upper part of the subsoil is brown gravelly coarse sandy loam about 3 inches thick, and the lower part is yellowish brown gravelly coarse sandy clay loam about 7 inches thick. Soft, weathered sandstone and siltstone are at a depth of about 14 inches.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Manburn gravelly coarse sandy loam, 10 to 40 percent slopes, in native grass, 800 feet south and 250 feet east of the center of sec. 25, T. 11 N., R. 81 W.:

A1—0 to 4 inches; grayish brown (10YR 5/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 20 percent gravel; slightly acid; clear smooth boundary.

B1—4 to 7 inches; brown (10YR 5/3) gravelly coarse sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to medium granular; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few thin patchy clay films on some peds and pebbles; 20 percent gravel and some cobbles; slightly acid; clear smooth boundary.

B2t—7 to 14 inches; yellowish brown (10YR 5/4) gravelly coarse sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure parting to fine subangular blocky; very hard, friable, slightly sticky and slightly plastic; thin patchy clay films on peds, in pores, and as clay bridges between sand grains; 25 percent gravel and some cobbles; neutral; gradual wavy boundary.

Cr—14 to 40 inches; soft sandstone and interbedded siltstone; reddish brown mottles.

The profile is 10 to 35 percent coarse fragments ½ inch to 10 inches in diameter. Reaction ranges from medium acid to mildly alkaline. The B2t horizon is gravelly loam, gravelly clay loam, or gravelly sandy clay loam. In the B2t horizon mottling is generally very weak or absent. In some places, the mottles are inherited from the parent material and do not indicate present drainage.

MbF—Manburn gravelly coarse sandy loam, 10 to 40 percent slopes. This soil is on upland ridges and mountainsides on the west flank of Independence Mountain in the northeastern part of the survey area. This unit has a high wind exposure and the precipitation is less effective. Much of the surface is strewn with boulders 1 to 6 feet in diameter.

Included with this soil mapping are small areas of Blevinton soils that are in wind-protected areas and along drainageways.

Runoff is medium. The hazard of soil blowing is moderate, and the hazard of water erosion is severe.

Most of the acreage of this soil is used for grazing. More vegetation is produced on this soil than on other soils of Bald Slopes range site. Capability unit VIIs–2, nonirrigated; Dry Exposure range site.

Mendenhall series

The Mendenhall series consists of deep, poorly drained soils that formed in calcareous alluvium. In places the soils are underlain by sand and gravel below a depth of 40 inches. They are on low terraces and flood plains between elevations of 7,800 and 8,600 feet. Slopes are 0 to 4 percent. The native vegetation is mainly tufted hairgrass, Nebraska sedge, ovalhead sedge, Baltic rush, willows, and cowparsnip. The mean annual precipitation is 10 to 15 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile an organic mat 2 to 6 inches thick is on the surface. The upper part of the surface layer is dark gray loam about 10 inches thick, and the lower part is gray sandy loam about 16 inches thick. The subsoil is light brownish gray sandy loam about 34 inches thick.

Permeability is moderate, and available water capacity is high.

These soils are used mainly for irrigated hay and pasture.

Representative profile of Mendenhall loam in native grass, 1,550 feet west and 1,725 feet south of the northeast corner of sec. 3, T. 8 N., R. 79 W.:

O1—3 inches to 0; undecomposed organic material, mostly the remains of grasses.

A11—0 to 10 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate, medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 10 percent gravel; strongly calcareous; moderately alkaline; clear smooth boundary.

A12g—10 to 26 inches; gray (10YR 5/1) sandy loam, very dark gray (10YR 3/1) moist; common medium prominent mottles, reddish brown (5YR 5/3) and dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; many medium, few fine roots; 10 percent gravel; strongly calcareous; moderately alkaline; clear smooth boundary.

B2g—26 to 60 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; many large prominent mottles, reddish brown (5YR 5/3), dark yellowish brown (10YR 4/4), and dark gray (2.5Y 4/1) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel; strongly calcareous; moderately alkaline.

The profile is 0 to 35 percent coarse fragments ¼ inch to 10 inches in diameter. Reaction ranges from mildly alkaline to strongly alkaline. The dark-colored A horizon ranges from 20 to 50 inches in thickness.

Me—Mendenhall loam. This soil is on low terraces and flood plains along the Michigan and Platte Rivers near the center of the survey area. Slopes are 0 to 4 percent.

Included with this soil in mapping are a few small areas of soils, called slickspots, that are similar to Mendenhall soils but that have a high content of sodium; these slickspots are generally less than 1 acre in size. Also included in old oxbows are small areas of Fleer soils. Sand and gravel are below a depth of 40 inches in places.

Runoff is slow. The hazards of soil blowing and water erosion are slight. Generally, the water table is above a depth of 6 inches for most of the growing season. The soils are subject to overflow from adjacent streams in most years (fig. 9).

Most of the acreage of this soil is irrigated and used for grass hay and pasture. An organic mat 1 to 4 inches thick has formed on the surface and bright,

Figure 9.—**Mendenhall loam is subject to overflow during spring snowmelt.**

rust-colored mottles have formed throughout the profile. Capability units VIw–1, nonirrigated, and VIw–2, irrigated; Mountain Meadow range site.

Mine pits and dumps

Mn—Mine pits and dumps. This land type consists of mine pits, which are excavations from which soil and geological material have been removed, and dumps of waste rock from mining excavations. The material may be either from hard-rock mining or from coal strip mining.

Included with this mapping unit are small areas of undisturbed soils.

Generally, this land type supports very little vegetation. Capability unit VIIIs–1, nonirrigated; not placed in a range site.

Mirror series

The Mirror series consists of moderately deep, well drained soils that formed in weathered gneiss and schist. The soils are underlain by bedrock at a depth of 20 to 40 inches. They are on mountainsides above timberline between elevations of 9,800 and 12,000 feet. Slopes are 10 to 40 percent. The native vegetation is mainly tufted hairgrass, alpine timothy, Parry clover, sedges, willows, herbaceous cinquefoil, ligusticum, pedicularis, American bistort, and kobresia. The mean annual precipitation is 20 to 25 inches, the mean annual air temperature is 25° to 27° F, and the frost-free season is 10 to 20 days.

In a representative profile the surface layer is grayish brown gravelly sandy loam about 7 inches thick. The subsoil is light brown extremely stony sandy loam about 16 inches thick. The underlying material is yellowish brown extremely stony sandy loam. Fractured bedrock, gneiss, and schist is at a depth of about 32 inches.

Permeability is moderately rapid, and available water capacity is low.

These soils are mainly used for grazing.

Representative profile of Mirror gravelly sandy loam in an area of Mirror-Rock outcrop complex, in native grass, in unsurveyed area of Colorado State Forest, 1 mile north of Montgomery Pass, 425 feet west of ridge crest, along road, T. 7 N., R. 76 W.:

O1&O2—3 inches to 0; undecomposed and partially decomposed organic matter from plant roots.

A1—0 to 7 inches; grayish brown (10YR 52) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to moderate fine crumb; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 50 percent stones and gravel; strongly acid; clear smooth boundary.

B2—7 to 23 inches; light brown (7.5YR 6/4) extremely stony sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable, nonsticky and nonplastic; many to few fine roots; 70 percent stones and gravel; very strongly acid; gradual wavy boundary.

C—23 to 32 inches; yellowish brown (10YR 5/4) extremely stony sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 75 percent stones and gravel; very strongly acid; gradual irregular boundary.

R—32 to 40 inches; fractured gneiss and schist bedrock.

The profile is 35 to 70 percent rock fragments, mainly more than 10 inches in diameter. Reaction is strongly acid or very strongly acid. Depth to bedrock ranges from 20 to 40 inches.

Mo—Mirror-Rock outcrop complex. This complex is on mountainsides and ridges above timberline in the extreme eastern part of the survey area. Slopes are 10 to 40 percent. About 60 percent is Mirror gravelly

sandy loam and about 40 percent is Rock outcrop. Rock outcrop is on ridge crests and slope breaks and Mirror gravelly loam is on smoother slopes.

Included with this complex in mapping are a few small areas of poorly drained soils adjacent to streams and springs and small areas of rock streams.

Runoff is slow. The hazard of soil blowing is moderate, and the hazard of water erosion is severe.

This complex is used mainly for grazing and recreation. Mirror part in capability unit VIIe–2, nonirrigated, and Rock outcrop part in capability unit VIIIs–1, nonirrigated; Mirror part in Alpine Slopes range site, and Rock outcrop part not placed in a range site.

Mord series

The Mord series consists of deep, well drained soils that formed in fine textured glacial till. They are on old high alluvial fans and mountainsides between elevations of 8,500 and 9,200 feet. Slopes are 4 to 15 percent. The native vegetation is mainly Thurber fescue, Idaho fescue, nodding brome, blue wildrye, big bluegrass, American vetch, western wheatgrass, slender wheatgrass, shrubby cinquefoil, and herbaceous sage. Most areas have an open canopy of aspen. The mean annual precipitation is 18 to 24 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile the surface layer is grayish brown loam about 12 inches thick. The subsurface layer is light gray heavy loam and gravelly clay loam about 9 inches thick. The subsoil is brown gravelly light clay about 13 inches thick. The underlying material is pale brown gravelly clay loam.

Permeability is slow, and available water capacity is high.

These soils are used mainly for grazing and recreation.

Representative profile of Mord loam, 4 to 15 percent slopes, in native grass, 1,100 feet east of the northwest corner of sec. 35, T. 8 N., R. 77 W.:

A11—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; gradual smooth boundary.

A12—6 to 12 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; soft, friable, slightly sticky and slightly plastic; many fine roots; common krotovinas; neutral; clear smooth boundary.

A2—12 to 16 inches; light gray (10YR 7/2) heavy loam, grayish brown (10YR 5/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; 10 percent gravel; neutral; abrupt wavy boundary.

A&B—16 to 21 inches; mixed light gray (10YR 7/2) and brown (10YR 5/3) gravelly clay loam, grayish brown (10YR 5/2) and dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few thin clay films on some peds and in pores; 15 percent gravel; this horizon consists of material similar to that of underlying horizon embedded in lighter colored matrix similar to that of overlying horizon; neutral; gradual irregular boundary.

B2t—21 to 34 inches; brown (10YR 5/3) gravelly light clay, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium angular blocky; extremely hard, firm, sticky and plastic; few fine roots; thin continuous clay films on peds; 20 percent gravel and a few cobbles; slightly acid; diffuse wavy boundary.

C—34 to 60 inches; pale brown (10YR 6/3) gravelly heavy clay loam, brown (10YR 5/3) moist; massive; hard, friable, sticky and plastic; 20 percent gravel; medium acid.

The profile is 0 to 35 percent rock fragments. Reaction ranges from slightly acid to mildly alkaline.

MrD—Mord loam, 4 to 15 percent slopes. This soil is on old high alluvial fans and mountainsides in the eastern part of the survey area.

Included with this soil in mapping are a few small parks of soils that are similar to Mord soils but that lack the A2 horizon and are steeper. The amount of gravel varies within the profile and on the surface, according to position. Some of the higher areas have been overrun by cobbly material from above.

Runoff is medium to rapid. The hazard of soil blowing is slight and the hazard of water erosion is moderate.

This soil is mostly under aspen and an understory of grass. It is used mainly for grazing. A small acreage is cleared and irrigated and used for grass hay and pasture. If this soil is irrigated an organic mat 1 to 4 inches thick generally forms on the surface and bright rust-colored mottles form throughout the profile. Capability units VIe–1, nonirrigated, and VIe–8, irrigated; Subalpine Loam range site.

Morset series

The Morset series consists of deep, well drained soils that formed in mixed calcareous outwash. They are on old high terraces and outwash plains between elevations of 8,200 and 8,800 feet. Slopes are 1 to 15 percent. The native vegetation is mainly sheep fescue, pine needlegrass, muttongrass, streambank wheatgrass, junegrass, big sagebrush, low rabbitbrush, buckwheat, and low phlox. The mean annual precipitation is 15 to 18 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is grayish brown loam about 4 inches thick. The upper 3 inches of the subsoil is brown loam, the middle 8 inches is brown light clay loam, and the lower 3 inches is pale brown light clay loam in which lime has accumulated. The underlying material is white and light yellowish brown loam in which lime has accumulated.

Permeability is moderate, and available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated hay and pasture.

Representative profile of Morset loam, 1 to 15 percent slopes, in native grass, 500 feet east and 200 feet south of the west quarter-corner of sec. 22, T. 9 N., R. 78 W.:

A1—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 5 percent gravel; mildly alkaline; clear smooth boundary.

B1—4 to 7 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to medium granular; hard, firm, slightly sticky and slightly plastic; many fine and medium roots; few thin patchy clay films on peds and in pores; 5 percent gravel; mildly alkaline; clear smooth boundary.

B2t—7 to 15 inches; brown (7.5YR 5/3) light clay loam, dark brown (7.5YR 4/3) moist; moderate medium prismatic structure parting to medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; many fine and few medium roots; continuous clay films on peds and in pores; 5 percent gravel; mildly alkaline; clear wavy boundary.

B3ca—15 to 18 inches; pale brown (10YR 6/3) light clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few fine roots; few patchy clay films on peds and in pores; 5 percent gravel; concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

C1ca—18 to 33 inches; white (10YR 8/2) heavy loam, light gray (10YR 7/2) moist; massive; very hard, firm, slightly sticky and slightly plastic; 10 percent gravel; secondary calcium carbonate is mostly finely divided marl-like forms permeating entire horizon; violently effervescent; strongly alkaline; diffuse wavy boundary.

C2ca—33 to 60 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; massive; very hard, firm, slightly sticky and slightly plastic; 10 percent gravel; concretions and coatings of secondary calcium carbonate on gravel; strongly effervescent; moderately alkaline.

The profile is 5 to 20 percent coarse fragments ¼ inch to 10 inches in diameter. Reaction ranges from mildly alkaline to very strongly alkaline. Depth to a continuous horizon of secondary calcium carbonate and sulfate ranges from 10 to 60 inches. Calcium carbonate equivalent ranges from 15 to 50 percent.

MsD—Morset loam, 1 to 15 percent slopes. This soil is on old high terraces and outwash plains in the southeast-central part of the survey area.

Included with this soil in mapping are a few small areas of soils that are similar to Morset soils but that have cobbles and gravel below a depth of 40 inches. Also included are small areas of Cabin sandy loam on the outer edge of terraces and in slightly higher areas and Tiagos sandy loam on the downwind side of small ridges.

Runoff is medium. The hazards of soil blowing and water erosion are slight.

Most of the acreage of this soil is used for grazing. Some of the acreage is irrigated and used for grass hay and pasture. If this soil is irrigated an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–9, irrigated; Dry Mountain Loam range site.

Muggins series

The Muggins series consists of deep, well drained soils that formed in fine textured glacial till. They are on high alluvial fans and moraines between elevations of 8,500 and 9,200 feet. Slopes are 5 to 30 percent. The native vegetation is mainly lodgepole pine, Engelmann spruce, and subalpine fir and a moderate understory of oregongrape, sedges, bluegrass, vaccinium, heartleaf arnica, lupine, and low juniper. The mean annual precipitation is 20 to 25 inches, the mean annual air temperature is 30° to 34° F, and the frost-free season is 20 to 30 days.

In a representative profile the upper part of the surface layer is pinkish white loam about 8 inches thick, and the lower part is light reddish brown and reddish brown clay loam about 5 inches thick. The subsoil is reddish brown and yellowish red heavy clay loam and clay about 27 inches thick. The underlying material is reddish brown clay loam.

Permeability is slow, and available water capacity is high. Reaction is slightly acid above a depth of about 13 inches and medium acid below that depth.

These soils are used mainly for producing timber and for wildlife habitat. Some areas are used for recreation.

Representative profile of Muggins loam, 5 to 30 percent slopes, in forest, NW¼NW¼ sec. 27, T. 6 N., R. 82 W.:

O1—2 inches to 1 inch; undecomposed needles, bark, and twigs.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.

A2—0 to 8 inches; pinkish white (5YR 8/2) loam, reddish yellow (5YR 6/6) moist; weak thick platy structure parting to moderate medium granular; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; 5 percent gravel; slightly acid; clear smooth boundary.

A&B—8 to 13 inches; light reddish brown (5YR 6/4) and reddish brown (5YR 5/3) clay loam, reddish brown (5YR 5/4) and yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; very hard, firm, slightly sticky and plastic; few fine and medium roots; 10 percent gravel; thin patchy clay films on peds; slightly acid; gradual wavy boundary.

B21t—13 to 20 inches; reddish brown (5YR 5/3) heavy clay loam, reddish brown (5YR 5/4) moist; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and plastic; few fine roots; 10 percent gravel; moderate nearly continuous clay films on peds; medium acid; gradual wavy boundary.

B22t—20 to 32 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 5/6) moist; moderate coarse angular and subangular blocky structure parting to moderate medium angular and subangular blocky; extremely hard, firm, sticky and plastic; 10 percent gravel; moderate nearly continuous clay films on peds; medium acid; gradual wavy boundary.

B3—32 to 40 inches; yellowish red (5YR 5/6) heavy clay loam, yellowish red (5YR 4/6) moist; moderate very coarse subangular blocky structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; 10 percent gravel; thin patchy clay films on peds; medium acid; gradual wavy boundary.

C—40 to 60 inches; reddish brown (5YR 5/4) clay loam, yellowish red (5YR 5/6) moist; massive; very hard, firm, sticky and plastic; 10 percent gravel; medium acid.

The profile is 0 to 20 percent coarse fragments ½ inch to 10 inches in diameter. Reaction ranges from slightly acid to medium acid. A thin, dark-colored A1 horizon is present in some places.

MuE—Muggins loam, 5 to 30 percent slopes. This soil is on high alluvial fans and moraines on mountainsides in the southwestern part of the survey area.

Included with this soil in mapping are a few small areas of Muggins soils that have a few scattered large rocks on the surface and soils that contain up to 50 percent gravel and cobbles. Also included are small areas of Larand soils adjacent to stream channels.

Runoff is medium to rapid. The hazard of soil blowing is slight, and the hazard of water erosion is high.

Most of the acreage of this soil is in forest. A small amount is cleared and used for grazing. Capability unit VIe–1, nonirrigated; not placed in a range site.

Newcomb series

The Newcomb series consists of deep, somewhat excessively drained soils that formed in coarse textured glacial till. They are on old high terraces and glacial outwash plains between elevations of 8,500 and 9,500 feet. Slopes are 4 to 20 percent. The native vegetation is mainly lodgepole pine, spruce, and fir and a sparse understory of oregongrape, boxleaf myrtle, vaccinium, elk sedge, kinnikinnick, buffaloberry, lupine, and common juniper. The mean annual precipitation is 18 to 22 inches, the mean annual air temperature is 30° to 34° F, and the frost-free season is 20 to 30 days.

In a representative profile the surface layer is very dark grayish brown loam about 2 inches thick. The subsurface layer is very pale brown loam about 13 inches thick. The subsoil is light brown very gravelly loamy sand about 15 inches thick. The underlying material is light yellowish brown very gravelly loamy sand.

Permeability is moderate above a depth of about 15 inches and rapid below that depth. Available water capacity is moderate.

These soils are used mainly for producing timber. Some areas are used for recreation.

Representative profile of Newcomb loam in an area of Troutville-Newcomb association, in forest, 400 feet north and 1,550 feet east of the southwest corner of sec. 34, T. 8 N., R. 77 W.:

O1—2 inches to 1 inch; undecomposed organic material, mostly needles, bark, and twigs.

O2—1 inch to 0; partially decomposed organic material like that of horizon above.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; strong fine crumb structure; soft, very friable, slightly sticky and slightly plastic; many coarse and few fine roots; 10 percent gravel and cobbles; slightly acid; clear wavy boundary.

A2—2 to 15 inches; very pale brown (10YR 8/3) loam, pale brown (10YR 6/3) moist; weak thin platy structure parting to fine granular; soft, very friable, slightly sticky and slightly plastic; many coarse and few fine roots; 10 percent gravel and cobbles; slightly acid; gradual wavy boundary.

B2—15 to 30 inches; light brown (7.5YR 6/4) very gravelly loamy sand that contains lamellae of sandy loam and sandy clay loam, brown (7.5YR 5/4) moist; slightly hard, very friable, nonsticky and nonplastic; 60 percent gravel and cobbles; clay bridges between and on sand grains; neutral; gradual wavy boundary.

C—30 to 60 inches; light yellowish brown (10YR 6/4) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; massive; loose; 60 percent gravel and cobbles; neutral.

The profile is 35 to 80 percent coarse fragments ½ inch to 10 inches in diameter. Reaction is medium acid to mildly alkaline. The thin, dark-colored A1 horizon is absent in places.

Newcomb soils are mapped only in association with Troutville soils.

Nokhu series

The Nokhu series consists of deep, well drained soils that formed in moderately fine textured glacial outwash and alluvium. They are on glacial terraces, fans, and mountainsides between elevations of 8,400 and 9,400 feet. Slopes are 0 to 50 percent. The native vegetation is lodgepole pine, Engelmann spruce, alpine fir, and a moderate understory of oregongrape, elk sedge, boxleaf myrtle, vaccinium, common juniper, and ceneotus. The mean annual precipitation is 18 to 24 inches, the mean annual air temperature is 32° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile an organic mat 3 inches thick is on the surface. The surface layer is dark gray loam about 1 inch thick. The subsurface layer is light brownish gray loam about 13 inches thick. The subsoil is brown clay loam about 22 inches thick. The underlying material is pale brown light clay loam in which lime has accumulated.

Permeability is slow, and available water capacity is high.

These soils are used mainly for producing timber. Some areas have been cleared and are used for irrigated grass hay and pasture.

Representative profile of Nokhu loam, 0 to 25 percent slopes, in forest, 1,000 feet west and 100 feet south of northeast corner of sec. 23, T. 7 N., R. 78 W.:

O1—3 inches to 1 inch; undecomposed organic material, principally needles, bark, twigs, and leaves.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.

A1—0 to 1 inch; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; strong medium crumb structure; soft, very friable, slightly sticky and slightly plastic; many fine and few coarse roots; neutral; abrupt smooth boundary.

A2—1 inch to 6 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak thin platy structure parting to moderate fine and very fine granular; soft, very friable, slightly sticky and slightly plastic; many fine and coarse roots; neutral; clear smooth boundary.

A&B—6 to 14 inches; mixed light brownish gray (10YR 6/2) and brown (10YR 5/3) loam, grayish brown (10YR 5/2) and dark brown (10YR 4/3) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; thin patchy clay films on some peds and in pores; this horizon consists of seams and nodules of material similar to that of underlying horizon embedded in light colored matrix similar to that of overlying horizon; neutral; gradual wavy boundary.

B2t—14 to 32 inches; brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) moist; strong medium angular and subangular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; 5 percent gravel; continuous clay films on peds and in pores; neutral; gradual wavy boundary.

B3—32 to 36 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; moderate medium and coarse subangular blocky structure; extremely hard, firm, slightly sticky and slightly plastic; few fine roots; 5 percent gravel; thin patchy clay films on some peds, continuous coatings in pores; mildly alkaline; clear wavy boundary.

Cca—36 to 60 inches; pale brown (10YR 6/3) light clay loam, yellowish brown (10YR 5/4) moist; massive; very hard, firm, slightly sticky and slightly plastic;

5 percent gravel; visible concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline.

The profile is 0 to 20 percent coarse fragments. The A1 horizon is absent in some places. Reaction of the A2 and B2t horizons ranges from slightly acid to mildly alkaline. Depth to uniformly calcareous material ranges from 17 to 60 inches. Reaction of the Cca horizon ranges from moderately alkaline to strongly alkaline. Calcium carbonate equivalent of the Cca horizon ranges from 4 to 14 percent.

NoE—Nokhu loam, 0 to 25 percent slopes. This soil is on high terraces, fans, and mountainsides in the southern part of the survey area. It has the profile described as representative of the series.

Included with this soil in mapping are a few, long, narrow rock streams along drainageways, areas of soils that are similar to Nokhu soils but that contain as much as 35 percent coarse fragments in the substratum, and small areas of Larand fine sandy loam.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Most of the acreage of this soil is in forest and is used for producing timber and for recreation. A small acreage is irrigated and is used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–1, nonirrigated, and VIe–7, irrigated; not placed in a range site.

NoF—Nokhu loam, 25 to 50 percent slopes. This soil is on mountainsides in the southern part of the survey area.

Included with this soil in mapping are a few small areas of long, narrow rock streams along drainageways and small areas of soils that are similar to Nokhu soils but that contain as much as 35 percent coarse fragments in the substratum. In some areas rock makes up a large amount of the surface area. Also included are small areas of steep Larand fine sandy loam along drainageways.

Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Most of the acreage of this soil is in forest and is used for producing timber and for recreation. Capability unit VIIe–1, nonirrigated; not placed in a range site.

Norriston series

The Norriston series consists of deep, well drained soils that formed in glacial till and outwash. They are on glacial eskers, moraines, and terraces between elevations of 8,300 and 9,000 feet. Slopes are 0 to 12 percent. The native vegetation is mainly pine needlegrass, junegrass, muttongrass, streambank wheatgrass, bluebunch wheatgrass, squirreltail, low rabbitbrush, buckwheat, and big sagebrush. The mean annual precipitation is 10 to 15 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is grayish brown gravelly sandy loam about 9 inches thick. The subsoil is about 11 inches thick; the upper part is brown gravelly coarse sandy loam, and the lower part is pale brown very gravelly loamy coarse sand. The underlying material is pale brown very gravelly loamy coarse sand.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Norriston gravelly sandy loam, in native grass, 825 feet south and 650 feet west of center of sec. 1, T. 8 N., R. 82 W.:

A1—0 to 9 inches; grayish brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to strong fine granular; soft, very friable, nonsticky and nonplastic; many medium and few fine roots; 40 percent gravel and cobbles, mostly angular granite gravel; mildly alkaline; clear smooth boundary.

B2t—9 to 16 inches; brown (7.5YR 5/4) gravelly coarse sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure parting to medium granular; extremely hard, very friable, nonsticky and nonplastic; many fine roots; 40 percent gravel, mostly very fine angular granite gravel; thin patchy clay films on peds, in pores, and as bridges between sand grains; mildly alkaline; gradual wavy boundary.

IIB3—16 to 20 inches; pale brown (10YR 6/3) very gravelly loamy coarse sand, brown (10YR 5/3) moist; massive; hard, loose, nonsticky and nonplastic; 60 percent gravel, mostly fine and very fine angular granite gravel; few thin patchy clay films as bridges between sand and gravel; mildly alkaline; gradual wavy boundary.

IIC—20 to 60 inches; pale brown (10YR 6/3) very gravelly loamy coarse sand, brown (10YR 5/3) moist; massive; hard, loose, nonsticky and nonplastic; 60 percent gravel, mostly fine and very fine angular granite gravel; mildly alkaline.

The profile is 35 to 75 percent coarse fragments; the fragments range from ⅛ inch to 10 inches in diameter, but are mostly less than 1 inch in diameter. Content of medium and coarse angular sand that has a large proportion of flat bearing surfaces ranges from 15 to 90 percent. The profile is slightly acid to mildly alkaline. Depth to the IIC ranges from 10 to 20 inches.

Nr—Norriston gravelly sandy loam. This soil is on glacial eskers, moraines, and high terraces or benches in the southern and western parts of the survey area. Slopes are 0 to 5 percent.

Included with this soil in mapping are a few small areas in which slopes are as much as 10 percent and areas in which rock makes up a large amount of the surface area. Also included are small, slightly concave areas of Cabin soils.

Runoff is slow. The hazards of water erosion and soil blowing are slight.

Most of the acreage of this soil is used for grazing. A small acreage is used for recreation. Capability unit VIs–1, nonirrigated; Valley Bench range site.

Owen Creek series

The Owen Creek series consists of moderately deep, well drained soils that formed in material weathered from sandstone of the North Park Formation. The soils are underlain by soft sandstone at a depth of 20 to 40 inches. The soils are on upland hill crests, ridges, and mountainsides between elevations of 8,000 and 8,500 feet. Slopes are 3 to 12 percent. The native vegetation is mainly sheep fescue, pine needlegrass, muttongrass, streambank wheatgrass, junegrass, big sagebrush, low

rabbitbrush, buckwheat, and low phlox. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is dark grayish brown sandy loam about 8 inches thick. The upper part of the subsoil is brown sandy clay loam about 4 inches thick, the middle part is dark brown heavy clay loam about 8 inches thick, and the lower part is brown and very pale brown clay loam 5 inches thick in which lime has accumulated. The underlying material is very pale brown loam in which lime has accumulated. Weathered calcareous sandstone of the North Park Formation is at a depth of about 36 inches.

Permeability is slow, and available water capacity is moderate.

These soils are used mainly for grazing. Some areas are used for nonirrigated crops.

Representative profile of Owen Creek sandy loam, in native grass, 710 feet west and 400 feet south of northeast corner of sec. 32, T. 12 N., R. 80 W.:

A1—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to moderate medium granular; soft, very friable, nonsticky and nonplastic; many fine and medium roots; slightly acid; clear smooth boundary.

B1—8 to 12 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; many fine roots; thin patchy clay films on peds and in pores; neutral; clear smooth boundary.

B2t—12 to 20 inches; dark brown (10YR 4/3) heavy clay loam, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; extremely hard, firm, sticky and plastic; few fine roots; thin continuous clay films on peds; dark brown (10YR 3/3) coats on peds, same color moist; neutral; clear smooth boundary.

B3ca—20 to 25 inches; variegated brown (10YR 5/3) and very pale brown (10YR 7/3) clay loam, dark brown (10YR 4/3) and pale brown (10YR 6/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; thin patchy clay films on faces of peds and in pores; mildly alkaline; gradual wavy boundary.

Cca—25 to 36 inches; very pale brown (10YR 8/3) loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline; gradual wavy boundary.

IICr—36 to 40 inches; weathered fine grained calcareous sandstone of the North Park Formation.

The profile is 0 to 20 percent coarse fragments. The A and B horizons are slightly acid to mildly alkaline in reaction. The Cca horizon is moderately alkaline or strongly alkaline in reaction. Depth to the IICr horizon ranges from 20 to 40 inches. In some places thick lenses of gravel are between the Cca horizon and the sandstone.

Oc—Owen Creek sandy loam. This soil is on upland hill crests, ridges, and mountainsides in the northern part of the survey area. Slopes are 3 to 5 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of narrow ridges and mounds in which thin deposits of gravel are on the surface and small areas of Ethelman sandy loam on ridgecrests and in steeper areas.

Runoff is rapid. The hazards of water erosion and soil blowing are slight.

Most of the acreage of this soil is used for grazing. A small acreage is farmed and is used for nonirrigated crops. Capability units VIe–1, nonirrigated, and VIe–7, irrigated; Dry Mountain Loam range site.

On—Owen Creek-Norriston association. This association is on upland hill crests, ridges, mountainsides, and old glacial terraces in the northern part of the survey area. Slopes are 5 to 12 percent. This association is about 55 percent Owen Creek sandy loam and 25 percent Norriston sandy loam. This association consists of long, narrow ridges divided by deep drainageways. The Owen Creek soil is on the tops of the ridges and on long, smooth sides of the ridges; it has smoother or more gentle slopes. The Norriston soil is on the narrow ridge crests and on short, steeper, sloping, convex side slopes. The Owen Creek and Norriston soils have profiles similar to the ones described as representative of their respective series, but more gravel is on the surface.

Included with this association in mapping is about 20 percent Rock outcrop and gravel beds on eroded old terraces.

Runoff is rapid on the Owen Creek soil and slow on the Norriston soil. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or slight.

This association is used mostly for grazing. Owen Creek part in capability unit VIe–1, nonirrigated, and Norriston part in capability unit VIs–1, nonirrigated; both parts in Rocky Loam range site.

Parkview series

The Parkview series consists of moderately deep, well drained soils that formed in very stony glacial till over material weathered from rocks of the North Park Formation. These soils are underlain by weathered sandstone and siltstone at a depth of 20 to 40 inches. The soils are on upland hills and ridges between elevations of 8,500 and 9,400 feet. Slopes are 20 to 35 percent. The native vegetation is mainly bluebunch wheatgrass, mountain muhly, needleandthread, sheep fescue, pine needlegrass, junegrass, squirreltail, buckwheat, bitterbrush, low rabbitbrush, and big sagebrush. The mean annual precipitation is 16 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 25 to 35 days.

In a representative profile the surface layer is grayish brown very stony loam about 6 inches thick. The upper part of the subsoil is grayish brown extremely stony loam about 4 inches thick, and the lower part is brown extremely stony sandy clay loam about 25 inches thick. Soft siltstone and sandstone is at a depth of about 34 inches.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Parkview very stony loam, 20 to 35 percent slopes, in native grass, 1,580 feet east and 1,280 feet south of northwest corner of sec. 3, T. 6 N., R. 78 W.:

A1—0 to 6 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist;

strong fine crumb structure; soft, very friable, slightly sticky and slightly plastic; many fine and few medium roots; 50 percent stones; mildly alkaline; clear wavy boundary.

B1—6 to 9 inches; grayish brown (10YR 5/2) extremely stony loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure parting to medium granular; hard, very friable, slightly sticky and slightly plastic; many fine roots; 60 percent stones; few thin patchy clay films on peds; mildly alkaline; gradual wavy boundary.

B2t—9 to 30 inches; brown (10YR 5/3) extremely stony sandy clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few medium and fine roots; 60 percent stones; moderate continuous clay films on peds, in pores, and as coatings on coarse fragments; mildly alkaline; gradual wavy boundary.

B3—30 to 34 inches; brown (10YR 5/3) extremely stony light sandy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; 70 percent stones; thin patchy clay films on peds and in pores; mildly alkaline; gradual wavy boundary.

IICr—34 to 40 inches; noncalcareous sandy siltstone and soft sandstone.

The profile is 35 to 80 percent coarse fragments, mainly 10 to 24 inches in diameter. The profile is slightly acid to mildly alkaline in reaction. The B2t horizon is extremely stony sandy clay loam, loam, or clay loam.

PaF—Parkview very stony loam, 20 to 35 percent slopes. This soil is on upland hills and ridges.

Included with this soil in mapping are a few small areas of soils that are similar to Parkview soils but that lack the large amount of stones.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Most of the acreage of this soil is used for grazing. A small acreage is used for homesites and recreation. Capability unit VIIs–1, nonirrigated; Rocky Loam range site.

Peeler series

The Peeler series consists of deep, well drained soils that formed in old alluvium. They are on mountainsides and on side slopes of valley fill between elevations of 8,200 and 10,000 feet. Slopes are 5 to 40 percent. The native vegetation is mainly lodgepole pine and a sparce understory of oregongrape, elk sedge, juniper, vaccinium, heartleaf arnica, kinnikinnick, and lupine. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile an organic mat of partially decomposed and undecomposed needles and bark 2 inches thick is on the surface. The surface layer is very dark grayish brown sandy loam about 1 inch thick. The subsurface layer is mostly pale brown sandy loam about 10 inches thick. The upper part of the subsoil is brown gravelly sandy clay loam about 9 inches thick, and the lower part is brown gravelly coarse sandy loam about 4 inches thick. The underlying material is light yellowish brown coarse sandy loam.

Permeability is moderate, and available water capacity is moderate.

These soils are used mainly for producing timber. Some areas are used for recreation and wildlife habitat.

Representative profile of Peeler sandy loam, 5 to 25 percent slopes, in forest, 585 feet north and 1,475 feet east of southwest corner of sec. 14, T. 11 N., R. 81 W.:

O1—2 inches to 1 inch; undecomposed organic material of needles, bark, and twigs.

O2—1 inch to 0; decomposed organic material similar to that of horizon above.

A1—0 to 1 inch; very dark grayish brown (10YR 3/2) sandy loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; neutral; abrupt smooth boundary.

A2—1 inch to 7 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; weak medium platy structure parting to weak medium subangular blocky; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; 15 percent gravel; neutral; gradual smooth boundary.

A&B—7 to 11 inches; mixed light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/4) sandy loam, yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) moist; moderate subangular blocky structure parting to moderate medium granular; slightly hard, very friable, nonsticky and nonplastic; few fine roots; 15 percent gravel; this horizon consists of seams and nodules of material similar to that of underlying horizon embedded in matrix similar to that of overlying horizon; slightly acid; clear smooth boundary.

B2t—11 to 20 inches; brown (10YR 5/3) gravelly sandy clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; 20 percent gravel; thin nearly continuous clay films on peds; slightly acid; gradual wavy boundary.

B3—20 to 24 inches; brown (10YR 5/3) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; hard, friable, nonsticky and nonplastic; 20 percent gravel; few thin patchy clay films on peds and in pores; neutral; gradual wavy boundary.

C—24 to 60 inches; light yellowish brown (10YR 6/4) coarse sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, very friable, nonsticky and nonplastic; 15 percent gravel; neutral.

The profile is 10 to 35 percent coarse fragments. The profile is slightly acid to mildly alkaline in reaction. The thin, dark A1 horizon is absent in some places. The B2t horizon is gravelly sandy clay loam or heavy gravelly sandy loam.

PeE—Peeler sandy loam, 5 to 25 percent slopes. This soil is on mountains and on side slopes of valley fill. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that are similar to Peeler soils but that have a fine textured subsoil. Also included are small areas in which rock makes up a large amount of the surface area.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Most of the acreage of this soil is in forest. A small acreage is used for recreation. Capability unit VIe–3, nonirrigated; not placed in a range site.

PeF—Peeler sandy loam, 25 to 40 percent slopes. This soil is on mountainsides.

Included with this soil in mapping are a few small areas of soils that are similar to Peeler soils; however,

some of these soils have a fine textured subsoil, and some are moderately deep over sandstone and shale.

Runoff is medium. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Most of the acreage of this soil is in forest. Capability unit VIIe–1, nonirrigated; not placed in a range site.

Perceton series

The Perceton series consists of moderately deep, well drained soils that formed in weathered sandstone. They are underlain by soft sandstone at a depth of 20 to 40 inches. The soils are on mountainsides and upland hills between elevations of 8,200 and 9,500 feet. Slopes are 5 to 25 percent. The native vegetation is mainly lodgepole pine, Engelmann spruce, and alpine fir and a sparse understory of oregongrape, elk sedge, vaccinium, heartleaf arnica, kinnikinnick, buffaloberry, and lupine. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 20 to 30 days.

In a representative profile a layer of partially decomposed and undecomposed needles and bark 2 inches thick is on the surface. The surface layer is very pale brown and yellowish brown sandy loam about 20 inches thick. The upper part of the subsoil is yellowish brown sandy clay loam about 10 inches thick, and the lower part is pale brown sandy loam about 4 inches thick. Soft sandstone of the Coalmont Formation is at a depth of about 34 inches.

Permeability is moderate, and available water capacity is low.

These soils are used mainly for producing timber. Some areas are used for recreation and wildlife habitat.

Representative profile of Perceton sandy loam in an area of Perceton-Hyannis association, in forest, 400 feet north and 375 feet east of the west quarter-corner of sec. 17, T. 5 N., R. 78 W.:

O1—2 inches to 1 inch; undecomposed organic material, principally needles, bark, twigs, and leaves.

O2—1 inch to 0; partially decomposed organic material similar to that of the horizon above.

A2—0 to 10 inches; very pale brown (10YR 7/4) sandy loam, yellowish brown (10YR 5/4) moist; weak thick platy structure parting to fine granular; soft, very friable, nonsticky and nonplastic; many medium and few fine roots; 10 percent gravel and some cobbles; neutral; gradual wavy boundary.

A&B—10 to 20 inches; mixed very pale brown (10YR 7/4) and yellowish brown (10YR 5/4) heavy sandy loam, yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure parting to medium subangular blocky and coarse granular; slightly hard, very friable, nonsticky and nonplastic; few medium and fine roots; 5 percent gravel; thin patchy clay films on peds and in some pores; this horizon consists of nodules and seams of material like that of the underlying horizon embedded in light colored matrix like that of the overlying horizon; neutral; gradual wavy boundary.

B2t—20 to 30 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure parting to medium and fine subangular blocky; very hard, firm, slightly sticky and slightly plastic; few fine roots; 5 percent gravel; thin continuous clay films on peds and in pores; clay bridges between sand grains; neutral; gradual wavy boundary.

B3—30 to 34 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 5 percent gravel; few thin patchy clay films on some peds; neutral; gradual wavy boundary.

Cr—34 to 60 inches; soft noncalcareous interbedded sandstone and siltstone.

The profile is 5 to 35 percent coarse fragments, mostly ¼ inch to 10 inches in diameter. The profile is medium acid to mildly alkaline. A thin, dark colored A1 horizon is present in some places.

Ph—Perceton-Hyannis association. This association is on mountainsides and upland hills in the southern and western parts of the survey area. Slopes are 5 to 25 percent. This association is about 60 percent Perceton sandy loam and 40 percent Hyannis sandy loam. The Perceton soil is on concave and smooth topography, and the Hyannis sandy loam is on low ridges and convex slopes. Both soils have the profiles described as representative of their respective series.

Included with this association in mapping are a few small areas of Rock outcrop and of very shallow soils on ridge crests and at slope breaks. Also included are areas in which rock makes up as much as 30 percent of the surface area.

Runoff is slow to medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

This association is in forest and is used for producing timber, for recreation, and for wildlife habitat. Perceton part in capability unit VIe–4, nonirrigated, and Hyannis part in capability unit VIe–5, nonirrigated; not placed in a range site.

Pinkham series

The Pinkham series consists of deep, well drained soils that formed in glacial till. They are on moraines on mountainsides between elevations of 9,500 and 11,000 feet. Slopes are 10 to 60 percent. The native vegetation is mainly Engelmann spruce, subalpine fir, and a sparse understory of oregongrape, elk sedge, vaccinium, heartleaf arnica, juniper, and kinnikinnick. The mean annual precipitation is 22 to 30 inches, the mean annual air temperature is 28° to 32° F, and the frost-free season is 10 to 20 days.

In a representative profile, an organic mat of partially decomposed and decomposed needles, bark, and twigs 3 inches thick is on the surface. The surface layer is light brownish gray stony sandy loam about 4 inches thick. The subsoil is brown very stony sandy loam about 10 inches thick. The underlying material is brown extremely stony sandy loam.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for producing timber, for recreation, and for wildlife habitat.

Representative profile of Pinkham stony sandy loam in an area of Pinkham-Rock outcrop association, approximately 1,000 feet below timberline, on small trail road leading to Michigan Lake Basin, T. 6 N., R. 76 E.:

O1—3 inches to 1 inch; undecomposed organic material, mostly needles, bark, and twigs.

O2—1 inch to 0; partially decomposed organic material similar to that of horizon above.
A2—0 to 4 inches; light brownish gray (10YR 6/2) stony sandy loam, grayish brown (10YR 5/2) moist; moderate thin platy structure parting to fine granular; soft, very friable, nonsticky and nonplastic; many medium roots; 15 percent stones; strongly acid; abrupt smooth boundary.
B2ir—4 to 14 inches; brown (7.5YR 5/4) very stony sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure parting to medium granular; slightly hard, very friable, nonsticky and nonplastic; many medium and fine roots; 20 percent stones; many dark concretions and pellets of manganese and iron humates; strongly acid; gradual wavy boundary.
C—14 to 60 inches; brown (10YR 5/3) extremely stony sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few medium and fine roots above a depth of about 30 inches; 40 percent stones; strongly acid.

The upper part of the profile is 10 to 35 percent coarse fragments, and the lower part is 35 to 75 percent coarse fragments. The coarse fragments are dominantly stones 10 to 24 inches in diameter. Reaction ranges from very strongly acid to medium acid. A very thin, discontinuous, dark-colored A1 horizon is present in some places.

Pr—Pinkham-Rock outcrop association. This association is on glacial moraines and mountainsides in a narrow belt below timberline in the southeastern part of the survey area. Slopes are 10 to 60 percent. This association is about 55 percent Pinkham stony sandy loam and about 25 percent Rock outcrop. Rock outcrop is on ridge crests, cliffs, and slope breaks.

Included with this association in mapping are about 20 percent areas of Mirror and MacFarlane soils and small areas of poorly drained soils adjacent to stream channels.

Runoff is slow. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

This association is in forest and is used for producing timber, for recreation, and for wildlife habitat. Pinkham part in capability unit VIIs–1, nonirrigated, and Rock outcrop part in capability unit VIIIs–1, nonirrigated; not placed in a range site.

Randman series

The Randman series consists of deep, poorly drained soils that formed in noncalcareous outwash and alluvium. They are underlain by very gravelly sand at a depth of 20 to 40 inches. The soils are on low terraces and benches between elevations of 7,820 and 9,000 feet. Slopes are 1 to 4 percent. The mean annual precipitation is 10 to 15 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile an organic mat of grass roots and fleshy remains of grasses 1 inch thick is on the surface. The surface layer is grayish brown sandy loam about 6 inches thick. The upper 4 inches of the subsoil is grayish brown gravelly heavy sandy loam, and the lower 20 inches is light brownish gray gravelly sandy clay loam. Very gravelly sand is at a depth of about 30 inches.

Permeability is moderate above a depth of 30 inches and rapid below a depth of 30 inches. Available water capacity is moderate. The water table is at a depth of 0 to 15 inches during the irrigation season. These soils are wet most of the year.

These soils are irrigated and are used mainly for grass hay and pasture.

Representative profile of Randman sandy loam in irrigated hay, 650 feet east and 300 feet north of the southwest corner of sec. 35, T. 7 N., R. 79 W.:

O1—1 inch to 0; undecomposed organic material, mainly grass roots and fleshy remains of dead grasses.
A1g—0 to 6 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; common medium distinct mottles, dark reddish brown (5YR 3/4) and dark gray (2.5Y 4/1) moist; moderate fine crumb structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; clear wavy boundary.
B1g—6 to 10 inches; grayish brown (10YR 5/2) gravelly heavy sandy loam, very dark grayish brown (10YR 3/2) moist; many medium distinct mottles, reddish brown (5Y 4/4) and dark gray (2.5Y 4/1) moist; moderate fine subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine roots; 15 percent gravel and some cobbles; few thin patchy clay films on peds; mildly alkaline; gradual wavy boundary.
B2tg—10 to 30 inches; light brownish gray (2.5Y 6/2) gravelly sandy clay loam, grayish brown (2.5Y 5/2) moist; many large distinct mottles, olive yellow (2.5Y 6/6) and dark gray (2.5Y 4/1) moist; moderate coarse prismatic structure parting to medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; few fine roots; 20 percent gravel; nearly continuous clay films on peds and in pores; mildly alkaline; gradual wavy boundary.
IIC—30 to 60 inches; noncalcareous very gravelly sand; many large distinct light olive brown (2.5Y 5/6) mottles.

The profile is neutral to mildly alkaline. The dark-colored A horizon ranges from 5 to 15 inches in thickness. The profile is mottled from near the surface downward. Mottles range from distinct to prominent. Content of coarse fragments ½ inch to 10 inches in diameter ranges from 5 to 35 percent above the contrasting IIC horizon.

Ra—Randman sandy loam. This soil is on low terraces, high terraces, and benches throughout the survey area. Slopes are 1 to 4 percent. The water table is at a depth of 0 to 15 inches. This soil is not usually subject to overflow.

Included with this soil in mapping are a few small areas of soils that are similar to Randman soils but have pockets of calcareous material below the subsoil. Also included are small areas of Eachuston soils on narrow filled channels and on the outer edge of terraces or benches.

Runoff is slow. The hazards of water erosion and soil blowing are slight.

This soil is irrigated and used for grass hay and pasture. An organic mat 1 to 4 inches thick has formed on the surface and bright, rust-colored mottles have formed throughout the profile. Capability unit VIw–3, irrigated; not placed in a range site.

Rawah series

The Rawah series consists of moderately deep, well drained soils that formed in weathered, calcareous redbed shale of the Chugwater Formation. The soils are underlain by soft shale at a depth of 20 to 40 inches. The soils are on hills and ridges on uplands between

elevations of 8,300 and 9,000 feet. Slopes are 3 to 10 percent. The native vegetation is mainly bluebunch wheatgrass, needleandthread, mountain muhly, sheep fescue, junegrass, pine needlegrass, low rabbitbrush, big sagebrush, and buckwheat. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 35° to 37° F, and the frost-free season is 30 to 35 days.

In a representative profile the surface layer is brown loam about 4 inches thick. The upper 3 inches of the subsoil is reddish brown loam, the middle 8 inches is reddish brown light clay loam, and the lower 5 inches is light reddish brown heavy loam in which lime has accumulated. The underlying material is light reddish brown loam in which lime has accumulated. Calcareous red-bed shale and siltstone are at a depth of about 30 inches.

Permeability is moderate, and available water capacity is moderate.

These soils are used mainly for grazing. Some areas are irrigated and used for grass hay and pasture.

Representative profile of Rawah loam, 3 to 10 percent slopes, in native grass, 240 feet east and 1,550 feet south of the north quarter-corner of sec. 4, T. 9 N., R. 81 W.:

A1—0 to 4 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 5 percent gravel, mostly on surface; mildly alkaline; clear smooth boundary.

B1—4 to 7 inches; reddish brown (2.5YR 5/4) loam, dark reddish brown (2.5YR 2/3) moist; moderate fine subangular blocky structure parting to fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; thin patchy clay films on some peds; mildly alkaline; clear smooth boundary.

B2t—7 to 15 inches; reddish brown (2.5YR 5/4) light clay loam, reddish brown (2.5YR 4/4) moist; moderate medium prismatic structure parting to medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; thin patchy clay films on peds and in pores; mildly alkaline; clear smooth boundary.

B3ca—15 to 20 inches; light reddish brown (2.5YR 6/4) heavy loam, reddish brown (2.5YR 5/4) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few thin patchy clay films on peds, concretions of secondary calcium carbonate; slightly calcareous; moderately alkaline; gradual wavy boundary.

Cca—20 to 30 inches; light reddish brown (2.5YR 6/4) loam, reddish brown (2.5YR 5/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; concretions, thin seams, and streaks of secondary calcium carbonate; strongly calcareous; moderately alkaline; diffuse wavy boundary.

IICr—30 to 60 inches; calcareous red-bed shale and siltstone.

The profile is 0 to 15 percent coarse fragments ¼ inch to 10 inches in diameter. The B2t horizon ranges from neutral to moderately alkaline. Depth to uniformly calcareous material ranges from 8 to 30 inches. The Cca horizon ranges from moderately alkaline to strongly alkaline. Calcium carbonate equivalent ranges from about 3 to 14 percent.

RhD—Rawah loam, 3 to 10 percent slopes. This soil is on upland hills, ridges, and mountainsides, mostly in the west-central and eastern parts of the survey area.

Included with this soil in mapping are a few small areas of exposed shale in steeper areas and on slope breaks. Also included are small areas of soils that are similar to Rawah soils but that have a dark colored surface layer; these soils are adjacent to drainageways.

Runoff is medium. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–3, nonirrigated, and VIe–9, irrigated; Rocky Loam range site.

Rock land

Rk—Rock land. This land type is on dissected rocky uplands. It consists of shallow and very shallow soils, Rock outcrop, and loose slides of angular rock fragments (stones and boulders). Slopes are 25 to 80 percent. This land type is 50 percent or more exposed bedrock. Many kinds of rock, 3 or more in hardness, make up the outcrops and fragments. The principal types are sandstone, granite, basalt, andesite, schists, gneiss, and rhyolite. Interbedding of sandstone and shale is common.

This land type is nearly barren. It is used for very limited grazing, recreation, and wildlife habitat. Capability unit VIIs–2, nonirrigated; not placed in a range site.

Rock outcrop

Ro—Rock outcrop. This land type is in the mountainous part of the survey area between elevations of 7,900 and 12,000 feet. Slopes are 30 to 80 percent. This land is 90 percent or more exposed bedrock. Most of the rock is granite, gneiss, and schist. There are many sheer bluffs, crags, and talus slides. Vegetation is very sparse on this land type. A few conifers grow in crevices and cracks where fan material and moisture accumulate.

This land type produces little sediment.

Areas of this land type are inaccessible. Rock outcrop is used for wildlife habitat, recreation, and watershed. Capability unit VIIIs–1, nonirrigated; not placed in a range site.

Rogert series

The Rogert series consists of shallow, well drained soils that formed in weathered granite. They are underlain by hard bedrock at a depth of 10 to 20 inches. The soils are on mountainsides between elevations of 8,300 and 9,000 feet. Slopes are 10 to 25 percent. The native vegetation is mainly bluebunch wheatgrass, mountain muhly, needleandthread, pine needlegrass, junegrass, low rabbitbrush, big sagebrush, and buckwheat. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 32° to 34° F, and the frost-free season is 20 to 30 days.

In a representative profile the surface layer is dark gray gravelly sandy loam and dark brown very gravelly coarse sandy loam about 14 inches thick. Bedrock is hard granite.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Rogert gravelly sandy loam, 10 to 25 percent slopes, in native grass, 750 feet south and 900 feet west of the east quarter-corner of sec. 8, T. 10 N., R. 78 W.:

A11—0 to 4 inches; dark gray (7.5YR 4/1) gravelly sandy loam, very dark gray (7.5YR 3/1) moist; strong fine crumb structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 40 percent gravel, mostly fine and very fine angular granite gravel; neutral; clear smooth boundary.

A12—4 to 14 inches; dark brown (7.5YR 4/2) very gravelly coarse sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, very friable, nonsticky and nonplastic; many fine and medium roots; 50 percent gravel, mostly fine and very fine angular fragments of granite; neutral; abrupt wavy boundary.

R—14 inches; granite bedrock.

The dark colored A horizon ranges from 7 to 20 inches in thickness and usually extends to bedrock. Content of coarse fragments ranges from 35 to 80 percent; the fragments range from ⅛ inch to 10 inches in diameter but are mostly less than 1 inch in diameter. Reaction ranges from slightly acid to mildly alkaline. In some places a lighter colored C horizon is present.

RtE—Rogert gravelly sandy loam, 10 to 25 percent slopes. This soil is on mountainsides in the eastern part of the survey area.

Included with this soil in mapping are a few small areas of Rock outcrop and areas of soils that are similar to Rogert soils but that are more than 20 inches thick over bedrock.

Runoff is slow. The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Most of the acreage of this soil is used for grazing. Capability unit VIIs–2, nonirrigated; Rocky Loam range site.

Siebert series

The Siebert series consists of moderately deep, well drained soils that formed in weathered mica schist. They are underlain by bedrock at a depth of 20 to 40 inches. The soils are on mountainsides between elevations of 8,000 and 9,800 feet. Slopes are 5 to 25 percent. The native vegetation is mainly lodgepole pine, Engelmann spruce, subalpine fir, and a sparse understory of oregongrape, elk sedge, vaccinium, kinnikinnick, juniper, buffaloberry, and lupine. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 33° to 35° F, and the frost-free season is 30 to 35 days.

In a representative profile the surface layer is light brownish gray gravelly loamy sand about 15 inches thick. The subsoil is about 18 inches thick; it is mixed light brownish gray, yellowish brown, and light olive brown gravelly loamy sand that contains thin layers of sandy loam, loam, and sandy clay loam one-fourth to three-fourths inch thick. Partly weathered mica schist is at a depth of about 33 inches.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for producing timber, for recreation, and for wildlife habitat.

Representative profile of Siebert gravelly loamy sand in an area of Grimstone-Siebert association in forest, 425 feet north and 1,300 feet east of the south quarter-corner of sec. 32, T. 12 N., R. 81 W.:

O1—2 inches to 1 inch; undecomposed organic material, mostly needles, bark, twigs, and leaves.

O2—1 inch to 0; partly decomposed organic matter similar to that of horizon above.

A2—0 to 15 inches; light brownish gray (10YR 6/2) gravelly loamy sand, grayish brown (10YR 5/2) moist; weak thick platy structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; few coarse and medium roots; 40 percent gravel and cobbles and a few stones; enough mica in medium and large platelets to give fine earth fraction a soaplike consistence when moist and crushed; slightly acid; gradual wavy boundary.

B2t—15 to 33 inches; mixed light brownish gray (10YR 6/2), yellowish brown (10YR 5/4), and light olive brown (2.5Y 5/4) gravelly loamy sand that contains discontinuous lamellae, one-fourth to three-fourths inch thick, of sandy loam, loam, and sandy clay loam, grayish brown (10YR 5/2), dark yellowish brown (10YR 4/4), and olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure parting to fine subangular blocky and granular; slightly hard, very friable, nonsticky and nonplastic; few medium and fine roots; 45 percent gravel and cobbles and a few stones; thin continuous clay films on some peds, in some pores, and as bridges between some sand grains; enough mica flakes to give fine earth fraction a soaplike consistence when moist and crushed; slightly acid; gradual wavy boundary.

Cr—33 to 50 inches; partly weathered mica schist.

The profile is 35 to 75 percent coarse fragments ¼ inch to 10 inches in diameter. The sand and silt fractions are 5 percent to 40 percent or more flat mica platelets large enough to affect the physical condition of the soil. Reaction ranges from medium acid to neutral. A thin, dark colored A1 horizon is present in places.

Siebert soils are mapped only in association with Grimstone soils.

Spicerton series

The Spicerton series consists of deep, well drained to moderately well drained soils that formed in alluvial sediment from the Coalmont Formation. They are on low terraces and in depressions on uplands between elevations of 7,800 and 8,300 feet. Slopes are 0 to 5 percent. The native vegetation is mainly western wheatgrass, saltgrass, alkali bluegrass, alkaligrass, squirreltail, winterfat, greasewood, big sagebrush, and mat saltbush. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is pale brown sandy loam about 2 inches thick. The subsoil is brown clay about 10 inches thick. The underlying material is brown clay. Salts sufficient to affect plant growth have accumulated in the lower part of the subsoil and in the underlying material.

Permeability is slow. Available water capacity is moderate; however, much of the soil moisture is not available for plants because of the salt content.

These soils are used mainly for grazing. Some areas are used for irrigated grass hay and pasture.

Representative profile of Spicerton sandy loam, in native grass, 875 feet south and 700 feet west of the north quarter-corner of sec. 10, T. 8 N., R. 80 W.:

A2—0 to 2 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; weak thin platy structure parting to fine granular; soft, very friable, nonsticky and nonplastic; very few fine roots; 10 percent gravel, mostly on surface; strongly calcareous; strongly alkaline; abrupt smooth boundary.

B2t—2 to 10 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate medium columnar structure parting to fine angular blocky; extremely hard, firm, very sticky and very plastic; few fine and medium roots; thin continuous clay films on peds and in pores; strongly calcareous; very strongly alkaline; clear wavy boundary.

B3sa—10 to 12 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to fine angular blocky; extremely hard, firm, sticky and plastic; thin patchy clay films on peds and in pores; secondary accumulation of soluble salts as crystals and concretions; strongly calcareous; very strongly alkaline; diffuse wavy boundary.

Csa—12 to 60 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; massive; extremely hard, very firm, sticky and plastic; crystals, concretions, seams, and streaks of soluble salts; strongly calcareous; very strongly alkaline.

The profile is 0 to 15 percent coarse fragments ¼ inch to 10 inches in diameter. Reaction ranges from moderately alkaline to very strongly alkaline. A thin A1 horizon is present above the A2 horizon in some places. Depth to uniformly calcareous material ranges from 0 to 6 inches. Content of exchangeable sodium ranges from 15 to 30 percent in the B2t horizon but is more than 30 percent in the Csa horizon in places. Calcium carbonate equivalent in the Csa horizon ranges from about 3 to 14 percent.

Sp—Spicerton sandy loam. This soil is on low terraces and upland drainageways near the center of the survey area. Slopes are 0 to 5 percent.

Included with this soil in mapping are a few small areas of Spicerton soils that have an extremely high sodium content that prevents plant growth; these areas appear as slickspots. Also included are small areas of Boettcher and Bundyman soils.

Runoff is rapid. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. All areas of this soil receive run-in, and most areas are subject to flooding.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIIs–3, nonirrigated, and VIs–2, irrigated; Salt Flats range site.

Stumpp series

The Stumpp series consists of deep, somewhat poorly drained soils that formed in fine textured calcareous alluvium. The soils are underlain by very gravelly loamy sand at a depth of 20 to 40 inches. They are on flood plains, on low terraces, and in upland depressions between elevations of 7,820 and 8,500 feet. Slopes are 1 to 3 percent. The native vegetation is mainly saltgrass, sedges, alkali bluegrass, tufted hairgrass, western wheatgrass, greasewood, and low rabbitbrush. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is very dark gray clay loam about 3 inches thick. The subsoil is very dark gray clay about 23 inches thick. The underlying material is gray clay. Very gravelly loamy sand is at a depth of about 32 inches. Salts have accumulated in the subsoil and the underlying material.

Permeability is slow, and available water capacity is moderate. The water table is at a depth of 20 to 36 inches. These soils are subject to flooding in spring. The salts affect plant growth.

These soils are used for grazing. Some areas are used for irrigated pasture.

Representative profile of Stumpp clay loam, in native grass, 750 feet east and 400 feet south of the west quarter-corner of sec. 13, T. 7 N., R. 79 W.:

A1—0 to 3 inches; very dark gray (10YR 3/1) clay loam, very dark brown (10YR 2/2) moist; strong medium granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; slightly calcareous; strongly alkaline; abrupt smooth boundary.

B2tsa—3 to 16 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium columnar structure parting to fine angular blocky; extremely hard, very firm, very sticky and very plastic; many fine and medium roots; thin continuous clay films on peds and in pores; visible small concretions and crystals of calcium carbonate and other salts; strongly calcareous; very strongly alkaline; gradual wavy boundary.

B3sa—16 to 26 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; extremely hard, firm, very sticky and very plastic; few medium roots; thin patchy clay films on peds and in pores; crystals and concretions of calcium carbonate and other salts; strongly calcareous; very strongly alkaline; gradual wavy boundary.

C1sa—26 to 32 inches; gray (2.5Y 5/1) clay, dark gray (2.5Y 4/1) moist; massive; extremely hard, very firm, sticky and plastic; concretions, crystals, small seams, and streaks of secondary calcium carbonate, calcium sulfate, and other salts; strongly calcareous; strongly alkaline; abrupt wavy boundary.

IIC2—32 to 60 inches; very gravelly loamy sand.

The profile is 0 to 35 percent coarse fragments ¼ inch to 10 inches in diameter. Reaction ranges from moderately alkaline to very strongly alkaline. A thin, discontinuous A2 horizon is present in some places. Depth to uniformly calcareous material ranges from 0 to 6 inches. Visible salt normally has accumulated throughout the B2t horizon, but in some places the B2t horizon is free of visible salts. Content of exchangeable sodium in the solum ranges from 15 to 30 percent, but in some places content increases with depth and is more than 30 percent in the Csa horizon.

St—Stumpp clay loam. This soil is on flood plains, on low terraces, and in drainageways throughout the survey area. Slopes are 1 to 3 percent.

Included with this soil in mapping are a few small areas of Stumpp soils in which depth to sand and gravel is 15 inches to more than 60 inches. Also included are small areas of soils that have an extremely high content of sodium that severely affects plant growth and small areas of Spicerton soils.

Runoff is slow. The hazards of soil blowing and water erosion are slight. The water table is at a depth of 20 to 36 inches. This soil is subject to flooding in spring.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat

1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIIw–2, nonirrigated, and VIw–3, irrigated; Mountain Meadow range site.

Sudduth series

The Sudduth series consists of deep, well drained soils that formed in alluvium and colluvium from fine textured shale of the Pierre Formation. They are on alluvial fans and mountainsides between elevations of 8,600 and 9,500 feet. Slopes are 5 to 15 percent. The native vegetation is mainly Thurber fescue, Idaho fescue, big bluegrass, American vetch, slender wheatgrass, western wheatgrass, shrubby cinquefoil, herbaceous cinquefoil, and silver sagebrush. The mean annual precipitation is 18 to 20 inches, the mean annual air temperature is 34° to 36° F, and the frost-free season is 25 to 35 days.

In a representative profile the surface layer is dark grayish brown loam about 4 inches thick. The upper part of the subsoil is dark grayish brown light clay loam about 3 inches thick, and the lower part is grayish brown clay loam about 13 inches thick. The buried subsoil is light brownish gray, white, grayish brown, and light olive brown clay about 14 inches thick. The underlying material is light olive brown clay.

Permeability is slow, and available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated grass hay and pasture.

Representative profile of Sudduth loam, 5 to 15 percent slopes, in native grass, 600 feet east and 650 feet south of the center of sec. 13, T. 5 N., R. 82 W.:

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; clear smooth boundary.

B1—4 to 7 inches; dark grayish brown (10YR 4/2) light clay loam, very dark brown (10YR 2/2) moist; weak prismatic structure parting to strong fine subangular blocky; hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; few thin patchy clay films on peds and in pores; neutral; clear smooth boundary.

B2t—7 to 20 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong fine prismatic structure parting to strong fine subangular blocky; very hard, very friable, slightly sticky and slightly plastic; many fine roots; thin patchy clay films on peds and in pores; neutral; abrupt smooth boundary.

IIB&Ab—20 to 23 inches; mixed light brownish gray (2.5Y 6/2) and white (2.5Y 8/2) light clay, grayish brown (2.5Y 5/2) and light gray (2.5Y 7/2) moist; few fine distinct mottles, olive brown (2.5Y 4/4) moist; strong fine angular blocky structure; extremely hard, friable, sticky and plastic; 5 to 10 percent gravel forming a stone line; thin nearly continuous clay films on peds; this horizon is primarily clayey aggregates of material similar to that of underlying horizon embedded in lighter colored and coarser textured matrix; slightly acid; clear smooth boundary.

IIB21tb—23 to 30 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; strong fine and medium angular blocky structure; extremely hard, friable, sticky and plastic; few fine roots; thin nearly continuous clay films on peds and in pores; few glossy slickensides; wide cracks between peds when dry; neutral; gradual wavy boundary.

IIB3b—30 to 34 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5 4/3) moist; weak medium and coarse angular blocky structure; extremely hard, friable, sticky and plastic; few thin glossy slickensides; wide cracks between peds when dry; neutral; gradual wavy boundary.

IICb—34 to 60 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5 4/3) moist; massive; extremely hard, very firm, sticky and plastic; irregular cracks divide this horizon when dry; neutral.

The profile is 0 to 15 percent coarse fragments, mainly ½ inch to 10 inches in diameter. Reaction ranges from slightly acid to mildly alkaline. The A horizon and the upper part of the B horizon, which are darker colored than the horizons below, range from 16 to 50 inches in combined thickness.

SuE—Sudduth loam, 5 to 15 percent slopes. This soil is on alluvial fans and mountainsides in the southern part of the survey area.

Included with this soil in mapping adjacent to soils that support a spruce-fir vegetation are a few small areas of soils that are similar to Sudduth soils but that have a thin, leached subsurface layer 2 to 4 inches thick. Also included are small areas of steep Crespin clay and Carlstrom clay in areas of breaks.

Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. In some areas a perched water table is at a depth of about 20 inches in spring.

Most of the acreage of this soil is used for grazing. A small acreage is irrigated and used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–1, nonirrigated, and VIe–8, irrigated; Deep Clay Loam range site.

Tealson series

The Tealson series consists of shallow, well drained soils that formed in weathered sandstone. The soils are underlain by calcareous soft sandstone at a depth of 10 to 20 inches. They are on upland hills and ridges between elevations of 7,900 and 8,500 feet. Slopes are 2 to 30 percent. The native vegetation is mainly pine needlegrass, junegrass, needleandthread, bluebunch wheatgrass, muttongrass, streambank wheatgrass, low rabbitbrush, big sagebrush, and buckwheat. The mean annual precipitation is 11 to 14 inches, the mean annual air temperature is 35° to 37° F, and the frost-free season is 30 to 35 days.

In a representative profile the surface layer is brown sandy loam about 10 inches thick. The underlying material is olive channery sandy loam. Soft sandstone is at a depth of about 16 inches.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for grazing.

Representative profile of Tealson sandy loam in an area of Tealson-Rock land association in native grass, one-fourth mile north and one-eighth mile east of southwest corner of sec. 25, T. 9 N., R. 80 W.:

A1—0 to 10 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to strong fine granular;

soft, very friable, nonsticky and nonplastic; 10 percent gravel; mildly alkaline; clear wavy boundary.

C1—10 to 16 inches; olive (5Y 5/3) channery sandy loam, olive (5Y 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 20 percent sandstone channers; calcareous; moderately alkaline; diffuse wavy boundary.

C2—16 to 20 inches; calcareous soft sandstone.

The profile is 0 to 35 percent coarse fragments predominantly ¼ inch to 10 inches in diameter. Reaction ranges from neutral to moderately alkaline.

Te—Tealson-Rock land association. This association is made up of soils on upland hills and ridges mainly in the south-central part of the Area. Slopes are 8 to 30 percent. This association is about 55 percent Tealson sandy loam and about 25 percent Rock land. The Tealson soil mainly has slopes of 2 to 8 percent and is on ridges that are a few feet to 150 feet above present drainageways, are 50 to 300 feet wide, and are as much as 2 miles long. Rock land mainly has slopes of 8 to 30 percent and is exposed ridges and mounds of sandstone that are usually near the highest points on the landscape.

Included with this association in mapping is about 20 percent Cryorthents, steep, and Tiagos soils on the north and east leeward slopes of ridges and in some saddles and swales.

Runoff is medium to slow. The hazards of soil blowing and water erosion are slight.

This association is used for grazing. Capability unit VIIs–2, nonirrigated; Tealson part in Valley Bench range site, Rock land part not placed in a range site.

Tiagos series

The Tiagos series consists of deep, well drained soils that formed in noncalcareous alluvium. They are on glacial outwash terraces, alluvial fans, till plains, and upland slopes between elevations of 8,000 and 9,000 feet. Slopes are 2 to 20 percent. The native vegetation is mainly sheep fescue, pine needlegrass, muttongrass, bluebunch wheatgrass, streambank wheatgrass, junegrass, buckwheat, low rabbitbrush, and big sagebrush. The mean annual precipitation is 15 to 18 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 30 to 40 days.

In a representative profile the surface layer is grayish brown and brown fine sandy loam about 12 inches thick. The subsoil is brown fine sandy loam about 16 inches thick. The underlying material is pale brown fine sandy loam.

Permeability is moderately rapid, and available water capacity is high.

These soils are used mainly for grazing. Some areas are used for irrigated grass hay and pasture.

Representative profile of Tiagos fine sandy loam in an area of Fluetsch-Tiagos association, in native grass, near the northeast corner of sec. 12, T. 10 N., R. 80 W.:

A1—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 5 percent gravel; neutral; gradual wavy boundary.

A3—8 to 12 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; gradual wavy boundary.

B2t—12 to 24 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to coarse subangular blocky; hard, friable, nonsticky and nonplastic; few fine roots; 5 percent gravel; thin nearly continuous clay films on peds, as bridges between sand grains, in pores, and on underside of coarse fragments; neutral; gradual wavy boundary.

B3—24 to 28 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; hard, very friable, nonsticky and nonplastic; 5 percent gravel; neutral; diffuse wavy boundary.

C—28 to 60 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel; neutral.

The profile is 0 to 35 percent coarse fragments ¼ inch to 10 inches in diameter. Reaction ranges from neutral to mildly alkaline.

Tiagos soils are mapped only in association with Fluetsch soils.

Tine series

The Tine series consists of deep, well drained soils that formed in coarse textured alluvium. The soils are underlain by gravelly loamy sand at a depth of 15 to 25 inches. They are on terraces and outwash plains between elevations of 7,900 and 8,400 feet. Slopes are 2 to 5 percent. The native vegetation is mainly needleandthread, pine needlegrass, muttongrass, blue grama, sheep fescue, streambank wheatgrass, Sandberg bluegrass, bitterbrush, and big sagebrush. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is 36° to 38° F, and the frost-free season is 35 to 40 days.

In a representative profile the surface layer is brown sandy loam about 12 inches thick. The upper part of the underlying material is brown loamy fine sand about 6 inches thick, and the lower part, to a depth of about 60 inches, is brown gravelly loamy sand.

Permeability is rapid, and available water capacity is low.

These soils are used mainly for grazing. Some areas are used for irrigated grass hay and pasture.

Representative profile of Tine sandy loam, in native grass, 300 feet north of center of sec. 6, T. 10 N., R. 79 W.:

A11—0 to 4 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; strong fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; 5 percent gravel; neutral; clear smooth boundary.

A12—4 to 12 inches; brown (7.5YR 5/3) sandy loam, dark brown (7.5YR 3/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; slightly hard, very friable, nonsticky and nonplastic; many fine roots; 5 percent gravel; mildly alkaline; gradual smooth boundary.

C1—12 to 18 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to single grained; slightly hard, very friable, nonsticky and nonplastic; few fine roots; 10 percent gravel; mildly alkaline; gradual wavy boundary.

IIC2—18 to 60 inches; brown (10YR 5/3) gravelly loamy sand, dark brown (10YR 4/3) moist; single grained; loose; 45 percent gravel and cobbles; mildly alkaline.

The upper part of the profile is 0 to 15 percent coarse fragments, and the lower part is 35 to 60 percent coarse fragments. Reaction ranges from slightly acid to mildly alkaline. Depth to the gravelly IIC2 horizon ranges from 15 to 25 inches.

Tn—Tine sandy loam. This soil is on broad high terraces and outwash plains. Slopes are 2 to 5 percent.

Included with this soil in mapping are a few small areas of soils that are similar to this Tine sandy loam but that have a high content of sodium and occur as small (less than one acre) slickspots. Small areas of Bangston soils are on higher dunelike areas.

Runoff is slow. The hazard of soil blowing is severe, and the hazard of water erosion is moderate.

This soil is used mainly for grazing. A small acreage is irrigated and is used for grass hay and pasture. If this soil is irrigated, an organic mat 1 to 4 inches thick generally forms on the surface and bright, rust-colored mottles form throughout the profile. Capability units VIe–5, nonirrigated, and VIe–10, irrigated; Sandy Bench range site.

Troutville series

The Troutville series consists of deep, well drained soils that formed in moderately coarse textured glacial till. They are on moraines and mountainsides between elevations of 8,500 and 10,500 feet. Slopes are 4 to 45 percent. The native vegetation is mainly lodgepole pine, Engelmann spruce, and subalpine fir and a sparse understory of oregongrape and elk sedge. The mean annual precipitation is 18 to 24 inches, the mean annual air temperature is 32° to 34° F, and the frost-free season is 20 to 30 days.

In a representative profile the upper part of the surface layer is pale brown sandy loam about 8 inches thick, and the lower part is light yellowish brown and dark brown gravelly sandy loam about 11 inches thick. The subsoil is about 21 inches thick; it is light yellowish brown very gravelly sandy loam that has thin layers of dark yellowish brown gravelly sandy clay loam and clay loam. The underlying material is light yellowish brown very gravelly sandy loam.

Permeability is moderately rapid, and available water capacity is low.

These soils are used mainly for timber production, for recreation, and for wildlife habitat.

Representative profile of Troutville sandy loam, 15 to 45 percent slopes, in forest, three-quarters mile south and one-half mile east of lumber camp, Colorado State Forest, NW¼ sec. 19, T. 17 N., R. 76 W. (unsurveyed):

O1—3 inches to 1 inch; undecomposed needles, bark, and twigs.

O2—1 inch to 0; partially decomposed organic materials similar to that of horizon above.

A2—0 to 8 inches; pale brown (10YR 6/3) sandy loam, dark yellowish brown (10YR 4/4) moist; moderate thin platy structure parting to moderate medium crumb; soft, very friable, nonsticky and nonplastic; few fine and medium roots; 15 percent gravel and stones; slightly acid; clear smooth boundary.

A&B—8 to 19 inches; mixed light yellowish brown (10YR 6/4) and dark brown (10YR 4/3) gravelly sandy loam, yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) moist; about 25 percent of horizon is thin lamellae of heavy sandy loam and light sandy clay; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; 35 percent gravel and stones; slightly acid; gradual wavy boundary.

B2t—19 to 40 inches; mixed light yellowish brown (10YR 6/4) and dark yellowish brown (10YR 4/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; about 70 percent of horizon is thin discontinuous lamellae of gravelly sandy clay loam and light clay loam; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and nonplastic; few medium and coarse roots; 40 percent gravel and stones; thin nearly continuous clay films on peds; slightly acid; gradual irregular boundary.

C—40 to 60 inches; light yellowish brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 50 percent gravel and stones; neutral.

The profile is slightly acid to neutral. A thin, dark-colored A1 horizon is present in some places. The A2 horizon ranges from very cobbly or very gravelly sandy loam to sandy loam; it is 10 to 60 percent coarse fragments. The B2t horizon ranges from very stony to very gravelly sandy loam; it is 35 to 75 percent coarse fragments. The C horizon ranges from very gravelly sandy loam to stony loamy sand; it is 25 to 80 percent coarse fragments.

ToF—Troutville sandy loam, 15 to 45 percent slopes. This soil is on slopes of glacial till on mountainsides, fans, and moraines. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that are similar to Troutville soils but that have a large amount of surface rock. Also included are areas of soils that are shallow over bedrock and small areas of steep Pinkham soils on north-facing slopes.

Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is severe.

Most of the acreage of this soil is in forest and is used for producing timber, for recreation, and for wildlife habitat. Capability unit VIIe–2, nonirrigated; not placed in a range site.

Tv—Troutville-Newcomb association. This association is on slopes of glacial till on mountainsides, fans, and moraines. Slopes are 4 to 20 percent. This association is about 60 percent Troutville sandy loam and 40 percent Newcomb loam. The Troutville soil has the smoother, long slopes, and the Newcomb soil has the short, steep slopes. The Troutville soil has a profile similar to the one described as representative of the Troutville series, but it has a thin, dark-colored surface layer and more cobbles. The Newcomb soil has the profile described as representative of the Newcomb series.

Included in mapping are a few small areas of Larand and Cowdrey soils in slightly depressional areas. Stones on the surface vary from few to many and range up to 3 feet in diameter.

Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

These soils are in forest. They are used for producing timber, for recreation, and for wildlife habitat. Troutville part in capability unit VIe–5, nonirrigated, and Newcomb part in capability unit VIe–3, nonirrigated; not placed in a range site.

Walden series

The Walden series consists of deep, poorly drained and somewhat poorly drained soils that formed in calcareous alluvium. The soils are underlain by very gravelly loamy sand at a depth of 20 to 40 inches. They are on terraces and benches between elevations of 7,900 and 8,200 feet. Slopes are 1 to 4 percent. There is no native vegetation left on this soil. The mean annual precipitation is 9 to 12 inches, the mean air temperature is 36° to 38° F, and the frost-free season is 35 to 45 days.

In a representative profile the surface layer is grayish brown sandy loam about 10 inches thick. The subsoil is grayish brown sandy clay loam about 12 inches thick. The underlying material is about 13 inches thick; it is white sandy clay loam in which lime has accumulated. Very gravelly loamy sand is at a depth of about 35 inches.

Permeability is moderate above a depth of about 35 inches and rapid below that depth to the water table. The available water capacity is moderate. All of this soil is irrigated.

These soils are used mainly for irrigated grass hay and pasture.

Representative profile of Walden sandy loam, in grass hay, 960 feet north and 575 feet west of the southeast quarter-corner of sec. 2, T. 8 N., R. 79 W.:

A1g—0 to 10 inches; grayish brown (2.5Y 5/2) sandy loam, very dark grayish brown (2.5Y 3/2) moist; many large prominent mottles, dark yellowish brown (10YR 4/4) moist; strong fine crumb structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; gradual wavy boundary.

B2g—10 to 22 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; many large prominent mottles, very dark gray (2.5Y 3/1) and olive brown (2.5Y 4/4) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; 5 percent gravel; mildly alkaline; clear wavy boundary.

Cca—22 to 35 inches; white (5Y 8/2) sandy clay loam, light gray (5Y 7/2) moist; many large prominent mottles, pale olive (5Y 6/3) and dark gray (5Y 4/1) moist; massive; hard, friable, slightly sticky and slightly plastic; 10 percent gravel; 29 percent finely divided soft powdery and marllike secondary calcium carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

IIC—35 to 60 inches; pale yellow (5Y 7/3) very gravelly loamy sand, pale olive (5Y 6/3) moist; massive; loose dry and moist, nonsticky and nonplastic; less secondary calcium carbonate than horizon above; calcareous.

The B2g horizon is 5 to 20 percent coarse fragments. Mottling ranges from few and distinct to many and prominent. The B2g horizon ranges from neutral to moderately alkaline. Depth to the calcic horizon ranges from 15 to 36 inches. The Cca horizon ranges from moderately alkaline to strongly alkaline. Calcium carbonate equivalent of the Cca horizon ranges from 15 to 40 percent.

Wa—Walden sandy loam. This soil is on terraces and benches near the center of the survey area. Slopes are 1 to 4 percent. The horizon that is high in calcium carbonate varies in depth and thickness and in places it is absent.

Included with this soil in mapping are a few small areas of Randman soils on slightly higher areas and Dobrow soils in low depressions.

Runoff is slow. The hazards of soil blowing and water erosion are slight. The seasonal high water table is at a depth of 4 to 12 inches. Many areas are subject to flooding and overflow.

This soil is irrigated and is used mainly for grass and pasture. An organic mat 1 to 4 inches thick generally has formed on the surface and bright rust-colored mottles have formed throughout the profile. Capability unit VIw–3, irrigated; not placed in a range site.

Wichup series

The Wichup series consists of deep, poorly drained soils that formed in moderately coarse textured alluvium. They are on flood plains and alluvial fans between elevations of 7,800 and 10,000 feet (fig. 10). Slopes are 1 to 5 percent. The native vegetation is mainly tufted hairgrass, Nebraska sedge, ovalhead sedge, Baltic rush, herbaceous cinquefoil, and willows. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 32° to 36° F, and the frost-free season is 20 to 40 days.

In a representative profile, an organic mat of peat that is partially decomposed grass roots and leaves 10 inches thick is on the surface. The surface layer is gray loam about 8 inches thick. The upper part of the subsoil is light brownish gray gravelly loam about 6 inches thick, and the lower part is light brownish gray fine sandy loam to a depth of more than 60 inches.

Permeability is moderate above the water table. Available water capacity is moderate. The water table is usually at or near the surface.

These soils are used mainly for grazing. Some areas are used for grass hay.

Representative profile of Wichup loam in native grass, center of NE¼ of sec. 32, T. 9 N., R. 77 W.:

O1—10 to 5 inches; brown calcareous fibrous sedge-rush peat; effervescent in upper 2 inches; mildly alkaline; gradual smooth boundary.

O2—5 inches to 0; black calcareous muck that has some plant residue forms and some mineral matter; neutral; gradual wavy boundary.

A1g—0 to 8 inches; gray (2.5Y 5/1) loam, black (2.5Y 2/0) moist; common medium distinct mottles, brown (7.5YR 4/4) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine to coarse roots; mildly alkaline; gradual wavy boundary.

B21g—8 to 14 inches; light brownish gray (2.5Y 6/2) gravelly loam, dark grayish brown (2.5Y 4/2) moist; many large prominent dark brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; 20 percent gravel; mildly alkaline; gradual wavy boundary.

B22g—14 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; common medium distinct olive brown (2.5Y 4/3) and dark brown (10YR 4/3) mottles; massive; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel; mildly alkaline.

Content of rock fragments averages 0 to 15 percent but thin horizons that contain 15 to 35 percent gravel and cobbles are present in some places. The profile is mostly noncalcareous above a depth of more than 60 inches, but the O1 horizon is weakly calcareous in places. Some stratification is common. The organic layer is 4 to 12 inches thick. A horizon of muck is not present in all places, but if present

Figure 10.—Area of Wichup loam in valley. The water table is at or near the surface most of the time.

it is 1 to 6 inches thick. The A1g horizon is medium acid to mildly alkaline. The B2g horizon has distinct or prominent mottles of both bright and dull chroma. The B2g horizon is neutral or mildly alkaline.

Wc—Wichup loam. This soil is on flood plains and low alluvial fans. Slopes are generally 1 to 5 percent but are as much as 20 percent in some areas.

Included with this soil in mapping are small areas of soils that are similar to this Wichup loam but that have gravel above a depth of 40 inches; small areas of soils above timberline that are much colder than this Wichup soil and remain frozen much of the year; and small areas of soils that contain as much as 35 percent coarse fragments and have slopes of as much as 20 percent. Also included are some areas of peat 2 to 5 feet deep; these areas are 50 to 300 feet wide and as much as one-half mile long and are generally adjacent to streams.

Runoff is slow. The hazards of soil blowing and water erosion are slight. Most areas are subject to overflow. The water table is at or near the surface most of the time.

Most of the acreage of this soil is used for grazing. Many areas are so wet that they will not support the weight of cattle and are grazed only when the soil is frozen. A small acreage is cut for hay. Capability unit VIIw–1, nonirrigated; Mountain Meadow range site.

Yochum series

The Yochum series consists of moderately deep, well drained soils that formed in weathered red sandstone and shale of the Chugwater Formation. The soils are underlain by sandstone or shale bedrock at a depth of 20 to 40 inches. They are on mountainsides between elevations of 8,500 and 10,500 feet. Slopes are 35 to 65 percent. The native vegetation is mainly lodgepole pine, Engelmann spruce, and subalpine fir and a sparse understory of oregongrape, elk sedge, vaccinium, heartleaf arnica, common juniper, strawberry, and lupine. The mean annual precipitation is 20 to 30 inches, the mean annual air temperature is 30° to 34° F, and the frost-free season is 20 to 30 days.

In a representative profile, a layer of partially decomposed and undecomposed needles, bark, and twigs 2 inches thick is on the surface. The surface layer is light reddish brown gravelly sandy loam about 8 inches thick. The subsoil is about 18 inches thick; it is light reddish brown and reddish brown very gravelly sandy loam that has thin layers of heavy sandy loam and sandy clay loam, loam, and clay loam. The subsoil is underlain by reddish brown noncalcareous sandstone and siltstone.

Permeability is moderately rapid, and available water capacity is low.

These soils are used mainly for producing timber, for recreation, and for wildlife habitat.

Representative profile of Yochum gravelly sandy loam, 35 to 65 percent slopes, in forest, approximately 2.3 miles above lumber camp on Montgomery Pass road in NW¼ of sec. 29, T. 7 N., R. 76 W. (unsurveyed):

O1—2 inches to 1 inch; undecomposed organic material, principally needles, bark, twigs, and leaves.
O2—1 inch to 0; partially decomposed material similar to that of horizon above.
A2—0 to 8 inches; light reddish brown (5YR 6/4) gravelly sandy loam, reddish brown (5YR 5/4) moist; weak thick platy structure parting to medium granular; soft, very friable, nonsticky and nonplastic; few coarse and medium roots; 20 percent gravel; medium acid; clear wavy boundary.
B2t—8 to 26 inches; mixed light reddish brown (5YR 6/4) and reddish brown (2.5YR 5/4) very gravelly sandy loam, reddish brown (5YR 5/4) and reddish brown (2.5YR 4/4) moist; discontinuous lenses and seams of heavy sandy loam, sandy clay loam, loam, and clay loam; weak, medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few coarse to fine roots; 50 percent gravel; few patchy clay films on some peds, in pores, on some coarse fragments, and as bridges between sand grains; medium acid; gradual wavy boundary.
Cr—26 to 40 inches; reddish brown noncalcareous soft sandstone and siltstone.

The profile is 35 to 75 percent coarse fragments ¼ inch to 10 inches in diameter. Reaction ranges from medium acid to neutral. A thin, dark-colored A1 horizon is present in places. The B2t horizon varies in the amount of lamellae or thin layers of sandy loam, sandy clay loam, loam, or clay loam in the matrix of sandy loam. If a C horizon is present, it is gravelly or very gravelly sandy loam.

YoF—Yochum gravelly sandy loam, 35 to 65 percent slopes. This soil is on mountainsides in the southeastern part of the survey area.

Included with this soil in mapping are a few, small, slightly concave areas of soils that are similar to Yochum soils but that have a finer textured surface layer. Also included are small areas of soils that are more than 40 inches deep over bedrock, and areas of soils that have a moderate covering of stones as large as 3 feet in diameter on the surface.

Runoff is slow. The hazard of soil blowing is moderate and the hazard of water erosion is severe.

Most of the acreage of this soil is in forest and is used mainly for producing timber, for recreation, and for wildlife habitat. Capability unit VIIe–2, nonirrigated; not placed in a range site.

Use and management of the soils

This section first describes the capability classification system used by the Soil Conservation Service, and then it places the soils of the Area in nonirrigated capability units and in irrigated capability units. Management of irrigated soils for crops is discussed. Also in this section are discussions of management of the soils for woodland, range, wildlife, and recreation. Information on use of the soils in engineering is given, mainly in tables of properties and interpretations.

Capability grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations for range, for forest trees, or for engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. Capability Classes I through V do not occur in Jackson County Area. The numerals indicate progressively greater limitations and narrower choices for practical uses, defined as follows:

Class I soils have few limitations that restrict their use.
Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
Class III soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.
Class IV soils have very severe limitations that reduce the choice of plants or require very careful management, or both.
Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.
Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, hay, range, woodland, or wildlife habitat.
Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife habitat.
Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, VIe. The letter *e* shows that the main limitation is risk of erosion; *w* shows that water in or on the soil inter-

feres with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in some parts of the United States but not in this Area, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, VIe–4 or VIIIs–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

Nonirrigated soils

The cool, semiarid climate, the short growing season, and the low precipitation in the Area prevent the growing of most field crops. The soils are restricted principally to range or timber. Therefore, although the soils are placed in nonirrigated capability units, management of these soils is discussed in the sections "Range" and "Woodland."

Nonirrigated capability units

On the following pages the nonirrigated capability units in Jackson County Area are described. The least restricted nonirrigated soils in the survey area are in capability class VI.

Capability unit VIe–1, nonirrigated

This unit consists of deep to moderately deep, well drained soils. The surface layer is sandy loam to clay, and the subsoil is heavy clay loam or clay. Some of the soils are underlain by soft shale at a depth of 20 to 40 inches. Slope ranges from 0 to 50 percent, but it is mostly 3 to 30 percent. Annual precipitation is 9 to 25 inches, and the frost-free season is 20 to 45 days for most of the soils.

Permeability is generally slow, and available water capacity is moderate or high. Runoff is medium or rapid. The hazard of erosion is slight to severe.

The soils in this unit are used mostly for grazing or woodland.

Capability unit VIe–2, nonirrigated

This unit consists of moderately deep, well drained and moderately well drained soils. The surface layer is clay or heavy clay loam or a thin layer of loam, and the subsurface layer or subsoil is clay or clay loam. The soils are underlain by soft shale at a depth of 20 to 40 inches. Slope ranges from 2 to 15 percent. Annual precipitation is 9 to 12 inches, and the frost-free season is 30 to 45 days.

Permeability is slow, and available water capacity is low. Runoff is medium or rapid. The hazard of erosion is generally moderate.

The soils in this unit are used mostly for grazing. The soils that have a fine-textured surface layer crack when dry and are sticky and plastic when wet.

Capability unit VIe–3, nonirrigated

This unit consists of deep and moderately deep, well drained soils. The surface layer is loam, gravelly loam, fine sandy loam, or sandy loam; and the subsoil is clay loam, gravelly sandy clay loam, sandy clay loam, fine sandy loam, or sandy loam. One of the soils is underlain by soft shale at a depth of 20 to 40 inches. Slope ranges from 1 to 25 percent. Annual precipitation is 9 to 22 inches, and the frost-free season is 20 to 45 days.

Permeability is generally moderate or moderately rapid, and available water capacity is low to high. Runoff is slow or medium. The hazard of erosion is slight to severe.

The soils in this unit are used mostly for grazing and producing timber.

Capability unit VIe–4, nonirrigated

This unit consists mostly of moderately deep, well drained soils. The surface layer is sandy loam, fine sandy loam, or cobbly loam; and the subsoil is sandy clay loam, light clay loam, or very gravelly sandy clay loam. The soils are underlain by bedrock at a depth of 20 to 40 inches. Slope ranges from 0 to 25 percent. Annual precipitation is 14 to 25 inches, and the frost-free season is 20 to 40 days.

Permeability is generally moderate, and available water capacity is low. Runoff is medium or slow. The hazard of erosion is slight or moderate.

The soils in this unit are used mostly for producing timber. Some areas are in native grass and are used for grazing.

Capability unit VIe–5, nonirrigated

This unit consists of deep and moderately deep, well drained to somewhat excessively drained soils. The surface layer is gravelly loamy sand, fine sandy loam, or sandy loam; and the subsurface layer or subsoil and underlying material are sandy loam, fine sandy loam, gravelly sandy loam, gravelly loamy sand, very cobbly loamy sand, or loamy sand. Some of the soils are underlain by soft sandstone at a depth of 20 to 40 inches. Slope ranges from 0 to 25 percent. Annual precipitation is 12 to 24 inches, and the frost-free season is 20 to 45 days.

Permeability is rapid or moderately rapid, and available water capacity is low. Runoff is slow or medium. The hazard of soil blowing is high, and the hazard of water erosion is slight or moderate.

The soils in this unit are used mostly for grazing and producing timber. The coarse textured surface layer and low water holding capacity make seeding range and establishing trees difficult.

Capability unit VIs–1, nonirrigated

This unit consists of deep, well drained soils. The surface layer is gravelly sandy loam, and the subsoil is cobbly sandy loam. The soils are underlain by very gravelly coarse loamy sand. Slope ranges from 0 to 12 percent. Annual precipitation is 10 to 15 inches, and the frost-free season is 30 to 40 days.

Permeability is rapid, and available water capacity is low. Runoff is slow. The hazard of erosion is slight.

The soils in this unit are used mostly for grazing. The coarse textured surface layer and low water holding capacity make range seeding difficult.

Capability unit VIw–1, nonirrigated

This unit consists of deep, poorly drained soils. The surface layer is sandy loam, loam, or silty clay loam; and the subsurface layer is sandy loam, fine sandy loam, gravelly loam, or sandy clay loam. Some of the soils are underlain by sand and gravel at a depth of 20 to 40 inches. Slope ranges from 0 to 5 percent. Annual precipitation is 10 to 20 inches, and the frost-free season is 30 to 40 days.

Permeability is moderately rapid, moderate, or moderately slow; and available water capacity is moderate or high. Runoff is slow. The hazard of erosion is slight. These soils are naturally wet and are subject to flooding.

The soils in this unit are used mostly for grazing.

Capability unit VIIe–1, nonirrigated

This unit consists of deep, well drained soils. The surface layer is loam or clay loam; and the subsoil is sandy clay loam, clay loam, or clay. The soils are underlain by clay loam to sandy loam. Slope ranges from 10 to 50 percent. Annual precipitation is 16 to 24 inches, and the frost-free season is mostly 20 to 30 days.

Permeability is slow, and available water capacity is high. Runoff is rapid. The hazard of soil blowing is slight, and the hazard of water erosion is severe.

The soils are used mostly for producing timber. Because the slopes are so steep, these soils cannot generally be treated by equipment.

Capability unit VIIe–2, nonirrigated

This unit consists of moderately deep and deep, well drained soils. The surface layer is sandy loam, gravelly sandy loam, gravelly coarse sandy loam, or fine sandy loam; and the subsoil is very gravelly sandy clay loam, gravelly coarse sandy clay loam, very gravelly coarse sandy clay loam, gravelly sandy loam, or extremely stony sandy loam. Some of the soils are underlain by bedrock at a depth of 20 to 40 inches. Slope ranges from 10 to 65 percent. Annual precipitation is 18 to 25 inches, and the frost-free season is 10 to 30 days.

Permeability is generally moderate, and available water capacity is low. Some of the soils above timberline are very cold and are moderately rapidly permeable. Runoff is slow or medium. The hazard of erosion is severe.

The soils in this unit are used mostly for producing timber.

Capability unit VIIs–1, nonirrigated

This unit consists of deep and moderately deep, well drained soils. The surface layer is gravelly sandy loam, stony sandy loam, extremely stony sandy loam, extremely stony loam, cobbly loam, clay loam, or clay; and the subsoil or subsurface layer is clay to extremely stony coarse sandy loam. Some of the soils are underlain by bedrock at a depth of 20 to 40 inches. Slope ranges from 5 to 60 percent. Annual precipitation is 9 to 30 inches, and the frost-free season is 10 to 45 days.

Permeability is generally rapid to slow, and available water capacity is low to high. Runoff is slow to rapid. The hazard of erosion is slight to severe.

The soils in this unit are used mostly for grazing and producing timber.

Capability unit VIIs–2, nonirrigated

This unit consists of shallow, well drained soils. The surface layer is gravelly sandy loam, coarse sandy loam, or sandy loam; and the subsoil or subsurface layer is gravelly coarse sandy loam, very gravelly coarse sandy loam, or channery sandy loam. The soils are underlain by bedrock at a depth of 10 to 20 inches. Slope ranges from 10 to 70 percent. Annual precipitation is 11 to 20 inches, and the frost-free season is 20 to 35 days.

Permeability is moderate or rapid, and available water capacity is low. Runoff is slow to rapid. The hazard of water erosion is moderate or severe.

The soils in this unit are used mostly for grazing. The steep slopes and the stone-covered surface make these soils impossible to treat with equipment. The low water holding capacity and slow plant recovery make range improvement difficult.

Capability unit VIIs–3, nonirrigated

This unit consists only of Spicerton sandy loam. This is a deep, well drained to moderately well drained soil. The thin surface layer is sandy loam, and the subsoil is clay. Slope ranges from 0 to 5 percent. Annual precipitation is 10 to 12 inches, and the frost-free season is 30 to 40 days.

Permeability is slow, and available water capacity is moderate. Runoff is rapid. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. This soil generally receives extra water from higher lying areas.

The soil in this unit is used mostly for grazing. The content of sodium salts restricts plant growth.

Capability unit VIIw–1, nonirrigated

This unit consists of deep, poorly drained soils. The surface layer is loam, and the subsurface layer and underlying material are stratified loam and gravelly loam. Slope ranges from 0 to 5 percent. Annual precipitation is 10 to 20 inches, and the frost-free season is mostly 20 to 40 days.

Permeability is generally moderate, and available water capacity is moderate. Runoff is slow. The hazard of erosion is slight. The soils are subject to flooding annually. The water table is at or near the surface most of the year.

The soils in this unit are used mostly for grazing and wildlife habitat. The wetness of these soils makes treatment by equipment difficult or impossible. Some areas cannot be grazed until the surface has frozen in winter and will support the weight of livestock.

Capability unit VIIw–2, nonirrigated

This unit consists only of Stumpp clay loam, a deep, somewhat poorly drained soil. The surface layer is clay loam, and the subsoil is clay. The soil is underlain by sand and gravel at a depth of 20 to 40 inches. Slope ranges from 1 to 3 percent. Annual precipitation is 10 to 14 inches, and the frost-free season is 35 to 45 days.

Permeability is slow, and available water capacity is moderate. Runoff is slow. The hazard of erosion is slight.

The soil in this unit is used mostly for grazing. The content of sodium salts affects plant growth somewhat. If this soil is overgrazed, the surface may become crusted and greasewood increases. Grass seeding is difficult.

Capability unit VIIIe–1, nonirrigated

This unit consists only of Dune land, which is deep, excessively drained sand dunes. They are sand throughout. Slope ranges from 10 to 50 percent. Annual precipitation is about 15 inches, and the frost-free season is 30 to 35 days for most areas.

Permeability is rapid, and available water capacity is low. Runoff is slow. The hazard of erosion is severe.

The soils in this unit are used mostly for recreation and esthetic purposes. The soils are not vegetated. The unstable sand makes any management impossible.

Capability unit VIIIs–1, nonirrigated

This unit consists of Badland, Rock outcrop, and Mine pits and dumps. The Rock outcrop is exposed soft shale and hard granite bedrock.

Runoff is rapid. Badland produces much sediment.

The land types in this unit are not vegetated. They can be used only for wildlife habitat, watershed, and esthetic purposes.

Irrigated soils

The irrigated area in Jackson County Area is small, about 110,000 acres, but is is important to the economy of the Area. Hay produced on irrigated soils provides feed for base herds through winter. Meadows are also used for pasture, furnishing grazing late in fall and early in spring, when livestock are restricted from range (fig. 11). Grass-fattened cattle are generally marketed in fall after grazing on aftermath stubble of hay meadows. The irrigated acreage does not include naturally wet or seeped areas for which systems of irrigation have not been developed.

This section describes briefly some management practices that are important in the use of the irrigated soils in the Area. It also gives some guidelines for the efficient use of irrigation water. Then the irrigated capability units in the Area are described. Estimated yields are given for grass hay on the irrigated soils in Jackson County Area.

Management of irrigated soils

The cool, semiarid, continental climate of Jackson County Area restricts the crops that can be grown primarily to meadow and pasture. The annual precipitation, about 9 inches, is not sufficient to supply the water needed by most other crops. Reasonable crop production depends upon supplemental irrigation. The object of irrigation is to obtain the desired response from crops by controlling the moisture environment of the crops. In the field this is accomplished by wetting the soil to the desired depth without causing erosion, accumulation of salts, waterlogging, or undue water loss.

Figure 11.—Cattle feeding on hay late in spring in an irrigated hay meadow on Tiagos sandy loam.

The perennial streams that flow down from the surrounding mountains provide a ready source of water for irrigation. Most irrigation water in the Area comes directly from the rivers and creeks; about 15 to 20 percent comes from storage reservoirs. Most ditch laterals leading from the streams supply individual landowners. There are only a few major multiuser canals in the Area. Several landowners have small storage reservoirs. There are a few large irrigation reservoirs, such as MacFarland Reservoir, as well as some natural lakes, such as Lake John, that have been enlarged to store irrigation water.

The problems in managing the irrigated soils in this Area are the short growing season, low production, and poor drainage, both natural and induced by irrigation. Erosion is not a problem except in ditches, along stream channels, and during short periods of hay establishment. Soils are usually protected by a sod cover. The practices discussed here help to use irrigation water more efficiently, maintain or increase production, and control erosion.

Pastures and meadows in Jackson County Area are usually irrigated by flooding from contour ditches or gradient laterals running at intervals across the slope. As slope increases or as the soil becomes more erodible, the length of run is shortened and irrigation heads are reduced to control erosion and to increase irrigation efficiency.

On some meadows, irrigation water is allowed to run continuously as long as water is available. This practice waterlogs the soil. Excessive irrigation in spring, when an abundance of water is available, leaches plant nutrients from the soil; reduces the effect of applied fertilizer; encourages invasion by water-loving plants, sedges, and rushes; and reduces hay production. This practice also creates bogs and seep areas, which are difficult to graze or cut for hay.

Any type of intermittent irrigation is superior to continuous irrigation. The soil needs to aerate and

warm to encourage the better, more productive grasses. With proper irrigation and better composition of grasses, pasture and hay meadow respond to fertilizer and proper grazing use and become consistently more productive.

When hay meadow is plowed up, it is often planted to oats or rye. This permits smoothing of the soil and breaking up of the old sod before reseeding. To get a satisfactory seedbed on soils that have a thick sod requires special working that breaks up the sod. Successful seeding of hay and pasture is made on well prepared, clean, and firmly packed soil. Where irrigation water is available late in the year, meadows and pastures are seeded in August and September; this avoids some weed problems and shortens the time needed for the stand to become established. Where irrigation water is not available late in the year, meadows and pastures are seeded in spring.

Grasses that are suited to irrigated soils in Jackson County Area are smooth brome, orchardgrass, redtop, intermediate wheatgrass, timothy, reed canarygrass, creeping foxtail (Garrison), meadow fescue, and tall fescue. Suitable legumes are red clover, white clover, strawberry clover, alsike clover, milkvetch, and birdsfoot trefoil. Tall wheatgrass is well suited to the soils that are affected by salts, such as Spicerton and Stumpp soils.

Grasses and grass-legume mixtures require good management to be productive. Usually, stubble or leaf height is used to judge when a pasture is ready for grazing and when grazing should be stopped or rotated. A general guide is to have at least a 4-inch growth before grazing starts and to leave a 3-inch stubble at all times. This rule helps to maintain healthy, productive plants and reduce thinning and winterkill. The stubble also helps to control erosion and spread irrigation water. Dragging, smoothing, renovating, and overseeding help to maintain smooth meadows that have good plant composition.

Fertilizer, mostly nitrogen and phosphate, is needed for high production in meadows. Nitrogen is generally applied to the surface every year. Phosphate is better applied when the meadow or pasture is plowed before reseeding.

Leveling, irrigation pipelines, checks, drops, turnouts, and diversions may be needed or desirable on irrigated soils. Water-storage and head-stabilizing reservoirs help to supply irrigation water late in the season. Drainage may be practical and necessary in small areas. The need for drainage can be reduced by good water management.

Weed control is needed on many irrigated meadows. Noxious weeds such as Canada thistle are hard to control once they become established. They generally start on ditchbanks, on roadways, and in disturbed areas, and then they slowly invade the meadows. They can be controlled by clean cultivation and by spraying with proper chemicals. Soil sterilants can be used on small areas.

Haying starts late in July or early in August and often continues well into September. The earliest hay harvested is of the best quality.

Irrigated capability units

Only the soils in the Jackson County Area that are irrigated or have potential to be irrigated have been put into irrigated capability units.

Because of the short growing season, the least restricted soils in the survey area are in capability class VI. The irrigated capability units in the survey area are described in the following pages. It is assumed that adequate irrigation water is available and that irrigation is used for crop production.

Capability unit VIw–2, irrigated

This unit consists of deep, poorly drained soils. The surface layer is loam or silty clay; and the subsurface layer is sandy clay loam, gravelly sandy clay loam, or gravelly loam. The soils are underlain by sand and gravel at a depth of 20 to 40 inches. Slope ranges from 0 to 5 percent. Annual precipitation is 10 to 20 inches, and the frost-free season is 30 to 40 days for most of the soils.

Permeability is moderately slow or moderate, and available water capacity is high. Runoff is slow. The hazard of erosion is slight. The soils are naturally wet; they are subject to overflow, and the water table is near the surface most of the year.

The soils in this unit are used mostly for grass hay and pasture. Fertilizer generally gives only fair results because the wetness restricts the more productive grasses and legumes.

Capability unit VIw–3, irrigated

This unit consists of deep, poorly drained to somewhat poorly drained soils. The surface layer is sandy loam, loam, or clay loam; and the subsoil and subsurface layer are gravelly sandy loam, gravelly fine sandy loam, very gravelly loam, clay, or fine sandy loam. The soils are underlain by sand and gravel at a depth of 20 to 40 inches. Slope ranges from 0 to 5 percent. Annual precipitation is 10 to 15 inches, and the frost-free season is 20 to 45 days.

Permeability is slow, moderate, or moderately rapid; and available water capacity is moderate. Runoff is slow. The hazard of erosion is slight.

The soils in this unit are used mostly for grass hay and pasture. Some of the soils are naturally poorly drained, but in some of the soils poor drainage has been induced by irrigation. If the application of irrigation water is not carefully controlled, unproductive water-loving grasses increase. Artificial drainage is beneficial where outlets are available.

Capability unit VIw–4, irrigated

This unit consists only of Eachuston gravelly loam, a deep, poorly drained soil. The surface layer and subsurface layer are gravelly loam. The soil is underlain by very gravelly loamy sand below a depth of about 8 inches. Slope ranges from 1 to 5 percent. Annual precipitation is 12 to 15 inches, and the frost-free season is 35 to 40 days.

Permeability is rapid, and available water capacity is low. Runoff is slow. The hazard of erosion is moderate. This soil is subject to overflow. The water table is at or near the surface for most of the year.

The soil in this unit is used mostly for grass hay and pasture. Fertilizer generally gives only fair results unless the soil is artificially drained and irrigation water

is properly managed. If the soil is drained, the applications of irrigation water should be light and frequent.

Capability unit VIe–7, irrigated

This unit consists of deep and moderately deep, well drained soils. The surface layer is sandy loam, loam, or clay loam; and the subsoil is heavy clay loam, sandy clay loam, or clay. Some of the soils are underlain by soft shale or sandstone at a depth of 20 to 40 inches. Slope ranges from 3 to 25 percent. Annual precipitation is 9 to 22 inches, and the frost-free season is 20 to 45 days.

Permeability is slow or moderately slow, and available water capacity is high to low. Runoff is medium or rapid. The hazard of erosion is moderate.

The soils in this unit are used mostly for grass hay and pasture. Although these soils are well drained, they can become seeped under prolonged overirrigation. The soils respond well to fertilizer, and high-producing grasses and legumes grow well. Care is necessary to avoid erosion during seeding.

Capability unit VIe–8, irrigated

This unit consists of deep and moderately deep, well drained soils. The surface layer is loam or clay loam, and the subsoil is heavy clay loam, gravelly clay loam, or clay. Some of the soils are underlain by soft shale at a depth of 20 to 40 inches. Slope ranges from 0 to 20 percent, but it is generally 5 to 15 percent. Annual precipitation is 12 to 24 inches, and the frost-free season is 20 to 45 days.

Permeability is moderate or slow, and available water capacity is moderate or high. Runoff is medium or rapid. The hazard of erosion is slight to severe.

The soils in this unit are used mostly for grass hay and pasture. The soils respond well to fertilizer. Because of the slope, the irrigation head should be controlled to prevent erosion.

Capability unit VIe–9, irrigated

This unit consists of deep and moderately deep, well drained soils. The surface layer is loam, fine sandy loam, or sandy loam, and the subsoil is sandy clay loam, clay loam, gravelly clay loam, fine sandy loam, or sandy loam. Some of the soils are underlain by soft shale at a depth of 20 to 40 inches. Slope ranges from 1 to 20 percent, but it is generally 1 to 5 percent. Annual precipitation is 9 to 20 inches, and the frost-free season is 30 to 45 days.

Permeability is moderate or moderately rapid, and available water capacity is moderate or high. Runoff is slow or medium. The hazard of erosion is slight to severe.

The soils in this unit are used mostly for grass hay and pasture. Although these soils are well drained, they can become seeped if overirrigated. The soils respond to fertilizer and are well suited to high-producing grasses and legumes.

Capability unit VIe–10, irrigated

This unit consists of deep and moderately deep, well drained soils. The surface layer is sandy loam or fine sand, and the subsoil or subsurface layer is sandy clay loam, gravelly sandy clay loam, fine sandy loam, loamy fine sand, or loamy sand. Slope ranges from 0 to 25 percent, but it is generally 0 to 5 percent. Annual precipitation is 12 to 16 inches, and the frost-free season is 30 to 45 days.

Permeability is moderate, moderately rapid, or rapid, and available water capacity is low. Runoff is slow or medium. The hazard of soil blowing is severe, and the hazard of water erosion is moderate.

The soils in this unit are used mostly for grass hay and pasture. The hazard of soil blowing and the low water holding capacity limit the use and management of these soils. Soil blowing is a concern when the surface is bare during seeding. Applications of irrigation water should be light and frequent.

Capability unit VIs–2, irrigated

This unit consists only of Spicerton sandy loam, a deep, moderately well drained soil. The thin surface layer is sandy loam, and the subsoil and underlying material are clay. Slope ranges from 0 to 5 percent. Annual precipitation is 10 to 12 inches, and the frost-free season is 30 to 40 days.

Permeability is slow, and the available water capacity is moderate. Runoff is rapid. The hazard of soil blowing is moderate, and the hazard of water erosion is slight.

The soil in this unit is used mostly for pasture and grass hay. The high content of sodium salts affects plant growth; generally, only salt-tolerant grasses are suited. Because permeability is slow, excessive irrigation should be avoided to prevent waterlogging and growth of low-producing water-loving plants.

Predicted yields

Table 2 gives predicted yields for grass hay on the irrigated soils in Jackson County Area. The yields are based on ranch records, on interviews with ranchers and with members of the staff of the Colorado Agricultural Experiment Station, and on direct observation.

These estimates are averages. They serve as a guide to the relative productivity of the soils. They are not intended to apply directly to specific tracts of land for any particular year, because the soils differ somewhat from place to place, management practices differ from ranch to ranch, and weather conditions vary from year to year.

The following practices are considered to be part of the high level of management that was assumed in making the estimates:

1. Controlling erosion to the maximum extent feasible.
2. Maintaining soil fertility by applying fertilizer in accordance with soil fertility tests and recommendations of the Colorado Agricultural Experiment Station.
3. Applying adequate irrigation water.
4. Using an efficient irrigation system.
5. Growing grass and legume varieties that are suited to the area and the soil.
6. Controlling weeds by tillage and spraying.

Woodland

The woodlands in Jackson County Area are mostly

TABLE 2.—*Predicted yields per acre of grass hay on irrigated soils*

[All yields were estimated for a high level of management in 1974. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil	Irrigated grass hay
	Tons
Aaberg-Barishman association:	
Aaberg part	
Barishman part	1.5
Blackwell loam	2.0
Boettcher-Bundyman association:	
Boettcher part	2.0
Bundyman part	
Bosler sandy loam	2.5
Cabin sandy loam	2.5
Coalmont-Fluetsch complex	2.0
Dobrow loam	1.0
Eachuston gravelly loam	1.5
Fleer loam	1.5
Fluetsch-Tiagos association:	
Fluetsch part	2.5
Tiagos part	2.5
Forelle loam	2.5
Gelkie sandy loam, 2 to 15 percent slopes	2.5
Girardot silty clay loam	2.0
Kather clay loam, 5 to 20 percent slopes	2.0
Leavitt loam	2.5
Lymanson cobbly loam, 4 to 10 percent slopes	2.0
Mendenhall loam	2.0
Morset loam, 1 to 15 percent slopes	2.5
Nokhu loam, 0 to 25 percent slopes	2.0
Randman sandy loam	2.0
Rawah loam, 3 to 10 percent slopes	1.5
Spicerton sandy loam	1.0
Stumpp clay loam	1.0
Sudduth loam, 5 to 15 percent slopes	2.5
Walden sandy loam	2.0

near the outer edge of the Area. The Colorado State Forest in the southeastern part of the Area is predominantly timber, and Independence Mountain in the northwestern part is forested.

If properly managed, the woodlands produce, in addition to lumber and other forest products, grazing for livestock; water for livestock and domestic use; water supply protection; areas for recreations such as camping, picnicking, and nature study; summer homesites; and wildlife habitat.

The wooded soils in Jackson County Area generally have adequate natural moisture for storage in the soil during winter and for continuous growth during the growing season. Therefore, the depth and water holding capacity of the soil do not have a major limiting effect on overall production. The short growing season and the cold climate limit timber production. Woodland production differs little among the soils.

In Jackson County Area, windbreaks and shelterbelts are rarely successful on soils not now in trees. Therefore, no windbreak information is given in this survey. Assistance in planting windbreaks can be obtained from the local office of the Soil Conservation Service.

Forest cover types

Forest can be classified into forest cover types. A forest cover type is a stand of trees different from other stands. The composition and development of the cover type result from a given combination of soil, climate, slope exposure, and elevation. The forest cover type is identified by the species that make up 50 percent or more of the stand. The woodlands in Jackson County Area are in two forest types: lodgepole pine and spruce-fir.

Lodgepole Pine Type.—Between elevations of about 8,500 and 10,000 feet, lodgepole pine is the dominant forest type. This type is characterized by dense stands of small, straight trees. Often the growth is stagnated because of the close spacing of the trees; trees 100 years old may be only post size. Lodgepole pine is a "fire type": it becomes established after forest fires. Much of the lodgepole pine is the result of uncontrolled accidental and natural fires. Lodgepole pine will remain dominant for many years, but it commonly reverts in time to the spruce-fir type at the higher elevations. Quaking aspen is mixed with the pine in some areas. Also a fire type, the aspen stands will in time mostly revert to spruce-fir forest if burning does not recur. The understory of older, self-thinned stands provides good grazing for livestock and wildlife. Stands of younger lodgepole pine, unless thinned, generally provide little grazing.

Spruce-Fir Type.—At about 10,000 to 11,000 feet, or timberline, and in some protected areas at lower elevations, the spruce-fir type dominates. Englemann spruce and subalpine fir are the main species. Being naturally protected because of wind direction and moisture, this type has avoided much of the more recent fires that preceded establishment of lodgepole pine forest. Though it has undergone fire in historic times, the spruce-fir forest in the northern part of the area is generally much older than the lodgepole pine. Most of the commercial lumbering in the Area is on this forest type. At this elevation natural reproduction is much slower than it is lower on the mountains. Unless they are naturally protected, areas in which the forest has been removed by fire require an extremely long time to reestablish because the climate is harsh.

Woodland management and productivity

Information on management and productivity of woodland in Jackson County Area is given in table 3. In this table, each soil used for woodland is assigned an ordination symbol and is rated for various management concerns. Potential productivity is given for the dominant trees, and species are recommended for planting.

The *ordination symbol* expresses productivity, or site quality, and indicates selected soil properties associated with important hazards, restrictions, or limitations on woodland use and management. All soils in Jackson County are in the same productivity class, indicated by the *4* in the symbol. The letter in the symbol indicates the limiting soil properties. In this survey *f*, *r*, and *o* were used. The letter *f* means fragmental or skeletal soils and indicates that the soils are limited by a large amount of coarse fragments (2

millimeters to 10 inches in diameter) in the profile. The letter *r* means relief or slope and indicates that the soils are limited by steepness of slope. The letter *o* in the ordination symbol indicates that there are no significant limitations in woodland use and management.

Management concerns are rated slight, moderate, or severe to indicate the degree of major soil limitations.

Erosion hazard is the degree of potential soil erosion during logging operations with large ground equipment and during the period that the surface is exposed as seedings become established. Slope is the major factor. A rating of *slight* indicates that the problems in erosion control are slight or none. A rating of *moderate* indicates that some attention must be given to preventing soil erosion. A rating of *severe* means that intensive treatments, such as specialized equipment and methods of operation, must be used to minimize soil erosion.

Equipment limitation (trafficability) ratings indicate (1) the degree of slope, (2) presence and amount of stones and rock outcrop, (3) seasonal wetness, (4) physical soil characteristics that may limit equipment use, (5) possible injury to tree roots, destruction of soil structure, and decrease in soil stability by careless use of equipment, and (6) choice of equipment type and methods of operation (horse-drawn, wheel types, track types, winches, cables, etc.). A rating of *slight* indicates that equipment use is not restricted in kind or time of year. A rating of *moderate* indicates that equipment use is restricted in kind of operation by one or more factors, such as slope, stoniness, or seasonal wetness. A rating of *severe* indicates that special equipment is needed to harvest the timber and its use is severely restricted by one or more factors.

Seedling mortality indicates the proportion of naturally occurring or planted tree seedlings that do not mature, as influenced by kind of soil or topographic conditions. Plant competition is not assumed to be a factor. The ratings indicate (1) expected results from natural regeneration, assuming adequate seed supply; (2) expected results from planting or direct seeding; (3) choice and intensity of seedbed treatments; (4) grade of planting stock and type of planting methods needed; (5) possibility of replanting being required. A rating of *slight* means the expected mortality is 0 to 25 percent. A rating of *moderate* means the expected mortality is 25 to 50 percent. A rating of *severe* means the expected mortality is more than 50 percent.

Windthrow hazard is the danger of trees being blown over. The ratings indicate (1) specific soil properties such as shallowness, stoniness, droughtiness, or wetness that impede normal root development; (2) choice of soil or management goals; and (3) need for specialized practices to minimize losses, for example thinning and cutting, leaving protective borders, and not leaving isolated seed trees. A rating of *slight* means few trees or none are expected to be blown down. A rating of *moderate* means that some trees are expected to be blown down during periods of excessive soil wetness and high winds. A rating of *severe* means that many trees are expected to be blown down by moderate or high winds during periods of wetness.

Plant competition (brush encroachment) is the invasion or growth of brush species when openings are made in the canopy. The ratings indicate (1) choice of tree species and method of regeneration, (2) kind and intensity of soil preparation and stand maintenance treatment that may be needed, and (3) probability of obtaining adequate and immediate restocking. A rating of *slight* indicates that plant competition will neither prevent natural regeneration and early growth nor interfere with adequate development of planted seedlings. A rating of *moderate* indicates that plant competition will delay natural or artificial regeneration, establishment, and growth but will not prevent the development of fully stocked normal stands. A rating of *severe* indicates that competition will prevent natural or artificial regeneration unless intensive site preparation and maintenance such as brush management and removal of competitive species are practiced to facilitate the regeneration of fully stocked timber stands.

The *potential productivity* of merchantable trees is expressed as site index for each soil. Site index is based on the average height of dominant and codominant trees at a certain age; the base age is 100 years for lodgepole pine and 50 years for Englemann spruce and subalpine fir. Lodgepole pine that are 100 years old and 70 feet tall would give the soil they are on a site index of 70. Englemann spruce that are 50 years old and 50 feet tall would give the soil they are on a site index of 50. Expected yields per acre for managed lodgepole pine on a soil of site index 70, and harvesting guide, are given in table 4.

The *trees to plant* are those that are suitable for commercial wood production and that are suited to the soil.

Woodland understory vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants within the reach of livestock or grazing and browsing wildlife. A well-managed wooded area can produce enough understory vegetation to support optimum numbers of livestock or wildlife, or both (fig. 12).

The quantity and quality of understory vegetation vary with the kind of soil, the age and kinds of trees, the density of the canopy, and the depth and condition of the forest litter. The density of the forest canopy is a major influence because it affects the amount of light that understory plants receive during the growing season.

Table 5 shows, for each soil suitable for woodland, the potential for producing understory vegetation. The potential production is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the soil moisture is above average during the optimum part of the growing season; in a normal year soil moisture is average; and in an unfavorable year it is below average.

The table also lists the major native understory plants that grow on each soil and the percentage composition of each by air-dry weight. The kinds and percentages of understory plants listed in the table are those to be expected where canopy density is most nearly typical of forest that yields the highest production of wood crops.

TABLE 3.—*Woodland management*

[Only the soils suitable for production of

Soil name and map symbol	Ordination symbol	Management concerns		
		Erosion hazard	Equipment limitation	Seedling mortality
Agneston: Ag	4r	Severe	Moderate	Slight
Cowdrey: CoD	4o	Slight	Slight	Moderate
CoF	4r	Moderate	Moderate	Moderate
Grimstone: Gs[1]: Grimstone part	4o	Moderate	Slight	Slight
Siebert part	4f	Moderate	Slight	Moderate
Larand: LaE, LaF	4o	Slight	Slight	Slight
MacFarlane: Ma[1]: MacFarlane part	4r	Moderate	Moderate	Slight
Rock outcrop part not rated.				
Muggins: MuE	4o	Moderate	Slight	Moderate
Nokhu: NoE	4o	Slight	Slight	Slight
NoF	4r	Moderate	Moderate	Slight
Peeler: PeE	4o	Slight	Slight	Moderate
PeF	4r	Severe	Severe	Moderate
Perceton: Ph[1]: Perceton part	4o	Moderate	Slight	Slight
Hyannis part	4o	Moderate	Slight	Slight

and productivity

commercial trees are listed in this table]

Management concerns—Cont.		Potential productivity		Trees to plant
Windthrow hazard	Plant competition	Important trees	Site index	
Moderate	Slight	Lodgepole pine Engelmann spruce Subalpine fir	68 45 54	Lodgepole pine, Engelmann spruce, subalpine fir.
Moderate	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 57 45	Lodgepole pine, Engelmann spruce, subalpine fir.
Moderate	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 57 45	Lodgepole pine, Engelmann spruce, subalpine fir.
Moderate	Slight	Engelmann spruce Lodgepole pine Subalpine fir	50 70 40	Engelmann spruce, lodgepole pine, subalpine fir.
Moderate	Slight	Lodgepole pine Engelmann spruce Subalpine fir	69 50 39	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	70 58 42	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 60 46	Lodgepole pine, Engelmann spruce subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	66 56 56	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 64 48	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 64 48	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 55 43	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 55 43	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	72 55 40	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	68 58 43	Lodgepole pine, Engelmann spruce, subalpine fir.

TABLE 3.—*Woodland management*

Soil name and map symbol	Ordination symbol	Management concerns		
		Erosion hazard	Equipment limitation	Seedling mortality
Pinkham:				
Pr[1]:				
Pinkham part	4r	Severe	Severe	Slight
Rock outcrop part not rated.				
Troutville:				
ToF	4r	Severe	Severe	Slight
Tv[1]:				
Troutville part	4o	Moderate	Slight	Slight
Newcomb part	4o	Slight	Slight	Moderate
Yochum:				
YoF	4r	Severe	Severe	Slight

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior of

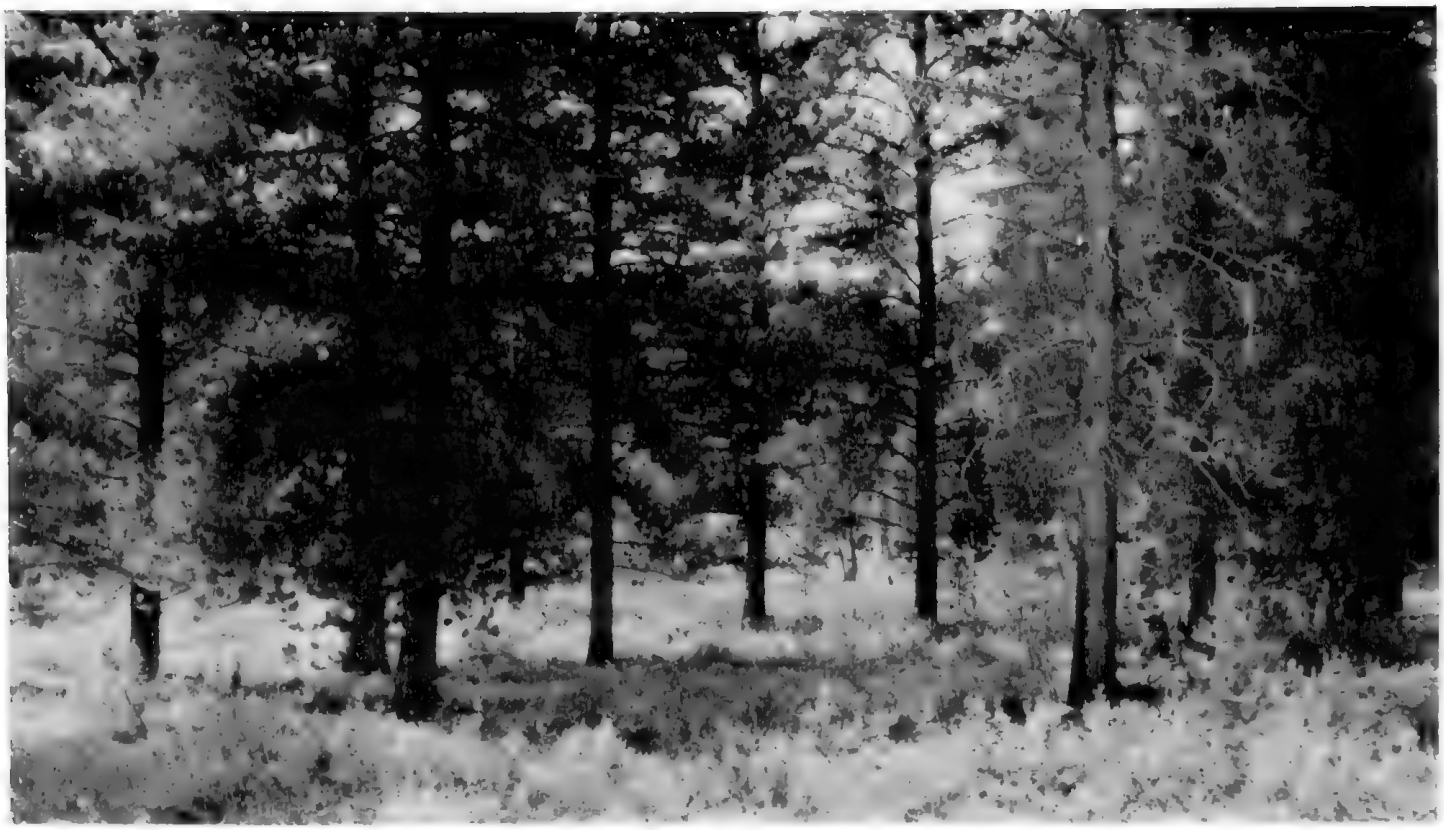

Figure 12.—**Open stands of lodgepole pine may provide grazing for livestock; Cowdrey soils.**

and productivity—Continued

Management concerns—Cont.		Potential productivity		Trees to plant
Windthrow hazard	Plant competition	Important trees	Site index	
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	74 57 45	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	76 59 45	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	76 59 45	Lodgepole pine, Engelmann spruce, subalpine fir.
Slight	Slight	Lodgepole pine Engelmann spruce Subalpine fir	70 60 45	Lodgepole pine, Engelmann spruce, subalpine fir.
Moderate	Slight	Lodgepole pine Engelmann spruce Subalpine fir	70 50 40	Lodgepole pine, Engelmann spruce, subalpine fir.

the whole mapping unit.

Range [8]

Livestock is the principal source of income in the Jackson County Area. Approximately 550,000 acres, 75 percent of the Area, is native range (fig. 13). Of this, about 50 percent is privately owned, 35 percent is individually leased publicly owned land administered by the Bureau of Land Management, and 15 percent is State-owned grazing land.

The Area is mainly a large, high, oval mountain park. The lower elevations consist of gently sloping and rolling, sagebrush-covered range dissected by meandering streams. Most of the Area is dry, receiving less than 15 inches of precipitation per year. Precipitation increases with elevation towards the surrounding mountains; production of vegetation increases with increasing moisture. The kinds and proportions of plants also change.

Near the center of the park big sagebrush is low-growing and sparse. Pine needlegrass, muttongrass, needleandthread, streambank wheatgrass, and bluebunch wheatgrass predominate (*3*). Total annual production of all vegetation averages about 600 pounds per acre.

In contrast, where the park floor meets the mountains big sagebrush is vigorous and robust and dominates the range. Idaho fescue, thickspike wheatgrass, nodding brome, native bluegrass, and needlegrasses and other productive grasses predominate. Total annual production of all vegetation averages about 3,000 pounds per acre.

[8] J. W. KELLOGG and JAMES E. PRESTON, range conservationists, Soil Conservation Service, helped to prepare this section.

The mountain meadows are vital to the livestock enterprise. Hay is produced on the ranch and fed to the livestock for at least 6 months, and another 1 or 2 months of grazing is obtained from the meadow in fall after haying. The feed furnished from the meadows as hay and grazing usually allows a carrying capacity in winter larger than what the native range can carry in spring and summer. Thus, too-early use and overuse of the native range are problems.

Native range is grazed from about May 15 to October 31. Nearly all of the range is grazed by cattle. Only a small part, mainly Alpine Slopes range site, is grazed by sheep.

Range sites and range condition

Soils that have the capacity to produce the same kinds, amounts, and proportions of range plants are grouped into range sites. A range site is the product of all environmental factors responsible for its development.

A plant community growing on a range site that has not undergone abnormal disturbance is the potential, or climax, plant community for that site. Climax plant communities are not precise or fixed in their composition but vary, within reasonable limits, from year to year and from place to place.

Abnormal disturbances such as overuse by livestock, excessive burning, erosion, or plowing result in changes in the climax plant community or even in complete destruction if disturbance is drastic enough. If the range site has not deteriorated significantly under such disturbances, secondary plant succession pro-

TABLE 4.—*Yields of lodgepole pine*

[Yields per acre of managed, even-aged stands of lodgepole pine in Colorado and Wyoming. Site index 70, 10-year cutting cycle]

Age of stand	Trees	Basal area	Average diameter at breast height	Average height	Volume			Periodic cut				
					Total	Merchantable	Sawtimber	Trees	Basal area	Total volume	Merchantable volume	Sawtimber volume
Yr	*No*	*Ft²*	*In*	*Ft*	*Ft³*	*Ft³*	*fbm*	*No*	*Ft²*	*Ft³*	*Ft³*	*fbm*
10	2,000	4	0.6	7								
30	1,550	110	3.6	28	1,550							
30	458	53	4.6	28	760			1,092	57	790	0	0
40	454	83	5.8	35	1,470	730						
40	355	72	6.1	35	1,280	730		99	11	190	0	0
50	353	97	7.1	41	2,010	1,540						
50	286	86	7.4	41	1,770	1,420		67	11	240	120	0
60	285	110	8.4	47	2,590	2,260						
60	231	95	8.7	47	2,260	2,000		54	15	330	260	0
70	231	116	9.6	52	3,040	2,770	6,200					
70	187	100	9.9	52	2,610	2,410	6,100	44	16	430	360	100
80	187	119	10.8	57	3,410	3,190	10,200					
80	149	100	11.1	57	2,870	2,690	9,100	38	19	540	500	1,100
90	149	119	12.1	62	3,710	3,510	13,600					
90	119	100	12.4	62	3,120	2,950	11,800	30	19	590	560	1,800
100	119	117	13.4	66	3,860	3,680	15,800					
100	98	100	13.7	66	3,320	3,160	13,800	21	17	540	520	2,000
110	98	116	14.7	69	4,000	3,820	17,400					
110	81	100	15.0	69	3,470	3,310	15,300	17	16	530	510	2,100
120	81	115	16.1	72	4,140	3,960	18,900	81	115	4,140	3,960	18,900

gresses in the direction of the climax plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if 51 to 75 percent; in fair condition if 26 to 50 percent; and in poor condition if less than 25 percent.

When the climax plant community changes because of use by livestock or disturbance, some plant species increase and others decrease. Which species increase or decrease depends upon the grazing animal, the season of use, and the degree of use. By comparing the composition of the present plant community with the potential plant community, it is possible to see how individual species increase while others decrease. Plants that are not in the climax community but that show up in the present plant community are invaders of the site.

The composition of climax and present plant communities, together with other range site information, provides the basis for selecting range management systems.

Management programs on range usually try to increase desirable plants and restore the range to as near climax condition as possible. Some programs are designed to create or maintain plant communities somewhat removed from the climax to fit specific needs in the grazing program, to provide wildlife habitat, or for other reasons. Any management objective should be compatible with conservation objectives.

Descriptions of the range sites

In the following pages, the 15 range sites in Jackson County Area are briefly described and the climax plants and principal invaders on the sites are named. Also given are estimates of the potential annual yield from range that is in excellent condition for favorable and unfavorable years. These yields are given as the normal high and low rather than the extremes. Yields are the total annual production of air-dry herbage in pounds per acre, including the year's growth of leaves, stems, twigs, and fruit of all plants on the site. Not all of this herbage is suitable forage for livestock. The site for each soil can be found in the soil descriptions.

Figure 13.—Area of Mountain Loam range site, which is at outer edge of park floor where rainfall is higher; Gelkie sandy loam.

Dry Mountain Loam range site

This range site is the most extensive in the Area. This site consists of moderately deep and deep, well drained soils. The surface layer is moderately coarse textured to medium textured. Slope ranges from 0 to 25 percent, but it is mostly 2 to 15 percent. Permeability is mostly moderate to moderately rapid, and available water capacity is low to high. Winter is extremely cold, and summer is cool. Annual precipitation is 9 to 18 inches; about two-thirds of this normally falls during the growing season.

The potential plant community is 15 percent streambank wheatgrass, 10 percent sheep fescue, 10 percent muttongrass, 8 percent pine needlegrass, 5 percent Letterman needlegrass, 3 percent Sandberg bluegrass, and 5 percent junegrass, bluebunch wheatgrass, squirreltail, and Nevada bluegrass. The grasses form a sparse stand beneath an open stand of big sagebrush, which makes up 15 percent of the community. Bitterbrush makes up 5 percent of the community, and low rabbitbrush makes up 3 percent. The community is also 3 percent lupine, 3 percent pussytoes, 3 percent aster, 3 percent fleabane, 2 percent yarrow, 2 percent bluebells, 1 percent buckwheat, 1 percent phlox, and 3 percent fringed sage, snakeweed, and other forbs.

The high proportion of grasses in the potential community makes this site suitable for grazing cattle. Heavy grazing by cattle causes grasses, such as bluebunch wheatgrass, sheep fescue, pine needlegrass, muttongrass, Nevada bluegrass, and Letterman needlegrass, to decrease and other plants, such as big sagebrush, blue grama, and the less palatable forbs, to increase.

Condition of the range vegetation can be improved, and forage production increased, by use of planned grazing systems, proper grazing practices, fencing, and brush management where needed.

The estimated total annual production of air-dry plant material ranges from 600 pounds per acre in poor years to 1,000 pounds per acre in good years. About 400 to 650 pounds per acre is suitable forage for cattle.

Valley Bench range site

This range site is extensive. It is on benches and uplands. This site consists of deep to shallow, well drained soils. The surface layer is moderately coarse textured. Slope ranges from 0 to 30 percent. Permeability is moderate or rapid, and available water capacity is low to high. Winter is extremely cold, and summer is moderately cool. Annual precipitation is 9 to 16 inches; about three-fourths of this falls during the growing season. This site is slightly more droughty than Dry Mountain Loam range site. The dry growing season strongly influences the kind and amount of potential vegetation on this site.

This site has a scrubby big sagebrush aspect. The potential plant community is 20 percent streambank wheatgrass, 15 percent muttongrass, 10 percent june-

TABLE 5.—*Woodland understory vegetation*

[Only the soils suitable for production of commercial trees are listed in this table]

Soil name and map symbol	Potential production		Common plant name	Composition
	Kind of year	Dry weight		
		Lbs/ac		*Pct*
Agneston:				
Ag.	Favorable	200	Vaccinium	20
	Normal	150	Heartleaf arnica	20
	Unfavorable	100	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
Cowdrey:				
CoD, CoF.	Favorable	250	Vaccinium	20
	Normal	200	Heartleaf arnica	20
	Unfavorable	150	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
Grimstone:				
Gs[1]:				
Grimstone part.	Favorable	250	Heartleaf arnica	20
	Normal	200	Vaccinium	20
	Unfavorable	150	Sedges	15
			Oregongrape	10
			Buffaloberry	5
			Kinnikinnick	5
			Boxleaf myrtle	5
			Strawberry	5
			Common juniper	5
			Unknowns	10
Siebert part.	Favorable	250	Vaccinium	20
	Normal	200	Heartleaf arnica	20
	Unfavorable	150	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Uknowns	10
Larand:				
LaE, LaF.	Favorable	200	Vaccinium	20
	Normal	150	Heartleaf arnica	20
	Unfavorable	100	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
MacFarlane:				
Ma[1]:				
MacFarlane part.	Favorable	250	Vaccinium	20
	Normal	200	Elk sedge	15
	Unfavorable	150	Oregongrape	10
			Lupine	10
			Strawberry	5
			Common juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Unknowns	25

TABLE 5.—*Woodland understory vegetation*—Continued

Soil name and map symbol	Potential production		Common plant name	Composition
	Kind of year	Dry weight		
		Lbs/ac		*Pct*
MacFarlane:				
Ma [1]:				
Rock outcrop part not estimated.				
Muggins:				
MuE.	Favorable	250	Heartleaf arnica	20
	Normal	200	Sedges	15
	Unfavorable	150	Oregongrape	10
			Bluegrasses	10
			Vaccinium	10
			Low juniper	5
			Kinnikinnick	5
			Strawberry	5
			Buffaloberry	5
			Lupine	5
			Unknowns	10
Nokhu:				
NoE, NoF.	Favorable	250	Vaccinium	20
	Normal	200	Elk sedge	15
	Unfavorable	150	Oregongrape	10
			Boxleaf myrtle	10
			Common juniper	5
			Buffaloberry	5
			Ceneothus	5
			Kinnikinnick	5
			Gamble oak	5
			Unknowns	20
Peeler:				
PeE, PeF.	Favorable	250	Vaccinium	20
	Normal	200	Heartleaf arnica	20
	Unfavorable	150	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
Perceton:				
Ph [1]:				
Perceton part.	Favorable	250	Vaccinium	20
	Normal	200	Heartleaf arnica	20
	Unfavorable	150	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
Hyannis part.	Favorable	200	Vaccinium	20
	Normal	150	Boxleaf myrtle	20
	Unfavorable	100	Elk sedge	15
			Oregongrape	10
			Lupine	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Ceneothus	5
			Unknowns	10

TABLE 5.—*Woodland understory vegetation*—Continued

Soil name and map symbol	Potential production		Common plant name	Composition
	Kind of year	Dry weight		
		Lbs/ac		*Pct*
Pinkham:				
PrF[1]:				
Pinkham part.	Favorable	250	Vaccinium	20
	Normal	200	Heartleaf arnica	20
	Unfavorable	150	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
Rock outcrop part not estimated.				
Troutville:				
ToF.	Favorable	250	Vaccinium	20
	Normal	200	Heartleaf arnica	20
	Unfavorable	150	Elk sedge	15
			Oregongrape	10
			Gamble oak	5
			Common juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
TvF[1]:				
Troutville part.	Favorable	250		
	Normal	200	Vaccinium	20
	Unfavorable	150	Heartleaf arnica	20
			Elk sedge	15
			Oregongrape	10
			Gamble oak	5
			Common juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10
Newcomb part.	Favorable	200		
	Normal	150	Vaccinium	20
	Unfavorable	100	Elk sedge	15
			Oregongrape	10
			Boxleaf myrtle	10
			Strawberry	5
			Common juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	20
Yochum:				
YoF.	Favorable	250	Vaccinium	20
	Normal	200	Heartleaf arnica	20
	Unfavorable	150	Elk sedge	15
			Oregongrape	10
			Strawberry	5
			Common juniper	5
			Buffaloberry	5
			Kinnikinnick	5
			Lupine	5
			Unknowns	10

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

grass, 9 percent Indian ricegrass, 5 percent pine needlegrass, and 5 percent other grasses. Big sagebrush makes up 15 percent of the community, and Douglas rabbitbrush makes up 3 percent; these are the main shrubs. The community is also 5 percent buckwheat, 5 percent phlox, 3 percent pussytoes, and 5 percent lupine, gray horsebrush, and other forbs.

This site is suitable for grazing livestock. Heavy grazing by cattle causes pine needlegrass, junegrass, and muttongrass to decrease and big sagebrush, Douglas rabbitbrush, and forbs to increase. If grazing is severe or prolonged, total production declines sharply.

Condition of the range vegetation can be improved by use of planned grazing systems and proper grazing practices, but response is slow. Because of the low precipitation, the success of range seeding is questionable. Results of seeding may be good in years of above-average precipitation. Brush management improves the range if it is needed and if there is a sufficient understory of climax plants.

The estimated total annual production of air-dry plant material ranges from 400 pounds per acre in poor years to 900 pounds per acre in good years. About 300 to 700 pounds per acre is suitable forage for livestock.

Mountain Loam range site

This range site is extensive. It is on edges of valley floors, on toeslopes of hills, and wherever else exposure produces higher effective precipitation than on Dry Mountain Loam range site. This range site consists of soils that have a moderately coarse textured or medium textured surface layer. Slope ranges from 2 to 20 percent. Permeability is moderately rapid to slow, and available water capacity is low to high. Winter is extremely cold, and summer is cool and dry. Annual precipitation is 15 to 20 inches; most of this falls during the growing season.

This site has an overstory of sagebrush and an understory of plants that are associated with a more moist environment than Dry Mountain Loam range site. The potential plant community is 15 percent Idaho fescue, 15 percent western wheatgrass, 8 percent Thurber fescue, 7 percent junegrass, 5 percent slender wheatgrass, 5 percent needlegrasses, 5 percent native bromes, and 2 percent other grasses. Yarrow, buckwheat, and penstemon are the most common forbs; each makes up 2 percent of the potential community. Other forbs make up 5 percent. The community is also 10 percent big sagebrush, 5 percent serviceberry, 3 percent rose, 3 percent shrubby cinquefoil, 2 percent snowberry, 2 percent low rabbitbrush, and 2 percent other shrubs.

Excessive grazing by cattle causes Idaho fescue, wheatgrass, native bromes, and Thurber fescue to decrease and other plants, such as big sagebrush, low rabbitbrush, and some forbs, to increase. If heavy grazing is prolonged, blue grama, three-awns, slimstem muhly, tall rabbitbrush, and knotweed invade.

Range vegetation responds well to proper grazing practices and use of planned grazing systems. Management of shrubby plants is practical if the proportion of shrubs is excessive, about 40 percent or more, and if there is a sufficient understory of climax plants. Seeding the range to suitable species is practical if the understory of climax plants is absent.

The estimated total annual production of air-dry plant material ranges from 1,200 pounds per acre in poor years to 1,800 pounds per acre in good years. About 800 to 1,200 pounds per acre is suitable forage for cattle.

Mountain Meadow range site

This site is extensive and is highly productive. It is along streams and is naturally subirrigated. This site consists of deep, poorly drained or somewhat poorly drained soils. The surface layer is medium textured or moderately fine textured. Slope ranges from 0 to 5 percent. Permeability is moderately slow to moderately rapid, and available water capacity is moderate or high. Winter is extremely cold, and summer is cool. Annual precipitation is 10 to 20 inches; about two-thirds of this falls during the growing season. The high water table and overflow strongly influence the kind and amount of vegetation on this site.

This site is characterized by dark green, lush growth. The potential plant community is 20 percent Thurber fescue, 12 percent tufted hairgrass, 10 percent slender wheatgrass, and 5 percent sedges; Baltic rush is also on this site. There are many forbs; the community is 3 percent iris, 3 percent herbaceous cinquefoil, 2 percent yarrow, and 15 percent wild celery, cowparsnip, clovers, American bistort, aster, arnica, groundsels, waterhemlock, false-hellebore, monkshood marshmarigold, sedum, fireweed, shooting-star, primrose, green gentian, elephanthead, and other forbs. The community is also 10 percent willow, 10 percent shrubby cinquefoil, 5 percent silver sage, and 5 percent other shrubs.

This site is used principally for grazing cattle. Because of its position on the valley floor and the lush, green vegetation, this site is usually heavily grazed. If range condition deteriorates, tufted hairgrass and slender wheatgrass decrease and plants that are not palatable to cattle increase. Gully erosion is common on this site when range vegetation is in poor condition.

Range vegetation responds well to use of planned grazing systems and proper grazing practices. Proper grazing practices are especially important because many plants are suited to the soils; therefore, the plants that are palatable to a particular animal are reduced by heavy grazing and are replaced by other, less palatable plants.

The estimated total annual production of air-dry plant material ranges from 2,000 pounds per acre in poor years to 4,000 pounds per acre in good years. About 1,500 to 3,000 pounds per acre is suitable forage for cattle.

Dry Exposure range site

This range site is extensive. It is on ridgetops where the winter snow blows off and the summer rain runs off. This site is, therefore, droughty and produces little vegetation. This site consists of well drained soils that are mostly less than 20 inches deep. The surface layer is gravelly and moderately coarse textured or medium textured. Slope ranges from 10 to 70 percent. Permeability is moderate, and available water capacity is low. Annual precipitation is about 15 to 18 inches;

about two-thirds of this falls during the growing season. Climate, degree and direction of slope, soil depth, and available water capacity strongly influence the kind and amount of vegetation on this site.

This site gives the appearance of being nearly bare ground; only stunted plants are present. The potential plant community is 25 percent wheatgrasses, 15 percent junegrass, 10 percent needleandthread, 5 percent Indian ricegrass, 5 percent blue grama, and 5 percent other grasses. The community is also 3 percent fleabane, 3 percent phlox, 3 percent pussytoes, 2 percent buckwheat, and 4 percent other forbs. Fringed sage makes up 10 percent of the community, and winterfat and low rabbitbrush each make up 5 percent.

Even if the site is in excellent condition, the plant cover is barely adequate to protect the soil from erosion. The site easily deteriorates under grazing, and erosion begins.

Little or no grazing should be permitted. Improvement of the vegetation is difficult and very slow. Complete deferment of grazing may be necessary.

The estimated total annual production of air-dry plant material ranges from 200 pounds per acre in poor years to 500 pounds per acre in good years. About 100 to 200 pounds per acre is suitable forage for livestock.

Rocky Loam range site

This site is moderate in extent. It consists of well drained soils that are mostly less than 40 inches deep over bedrock. The surface layer is generally stony, cobbly, and gravelly and is medium textured or moderately coarse textured. Slope ranges from 0 to 45 percent. Permeability is moderate to rapid, and available water capacity is moderate or low. The depth, volume of coarse fragments, and texture reduce the available water capacity of these soils and make them droughty. Winter is cold, and summer is cool. Annual precipitation is 10 to 20 inches; about two-thirds of this falls during the growing season. Soil and climate strongly influence the kind and amount of vegetation on this site.

The potential plant community is 10 percent streambank, thickspike, and bluebunch wheatgrasses; 10 percent Indian ricegrass; 10 percent sheep fescue; 10 percent Idaho fescue; 10 percent mountain muhly; 5 percent junegrass; and 6 percent other grasses. The community is also 5 percent phlox, 3 percent aster, 3 percent fleabane, 2 percent lupine, and 5 percent yarrow, hairy goldaster, buckwheat, herbaceous cinquefoil, herbaceous sage, paintbrush, milkvetch, and other forbs. The community is also 10 percent big sagebrush, 5 percent low rabbitbrush, 3 percent fringed sage, and 3 percent other shrubs.

This site is suitable for grazing livestock. Excessive grazing by cattle usually causes bluebunch wheatgrass, mountain muhly, Indian ricegrass, sheep fescue, and Idaho fescue to decrease and such plants as western wheatgrass, squirreltail, junegrass, big sagebrush, gray horsebrush, and forbs that are not palatable to cattle to increase. If vegetation is in poor condition, the hazard of erosion is severe.

Improvement of the range vegetation on this site is slow and difficult. Use of planned grazing systems and proper grazing practices, with time, improve and maintain the vegetation in excellent condition. Brush management requires a sufficient amount of climax plants. Range seeding is difficult because of rock fragments, slope, and droughtiness.

The estimated total annual production of air-dry plant material ranges from 500 pounds per acre in poor years to 1,400 pounds per acre in good years. About 400 to 1,100 pounds per acre is suitable forage for livestock.

Mountain Shale range site

This range site is moderate in extent. It is on rolling hills. This site consists of well drained soils that are 20 inches to more than 40 inches deep over shale. The surface layer is moderately fine textured or fine textured; stones are present in places. Slope ranges from 5 to 20 percent. Permeability is slow, and the available water capacity is low to high. The fine texture, permeability, and slope make runoff potentially rapid; erosion and sedimentation can become a problem. Winter is cold, and summer is cool. Annual precipitation is 9 to 15 inches; about three-fourths of this falls during the growing season. Runoff and climate strongly influence the kind and amount of vegetation on this site.

The potential plant community is 20 percent rhizomitous and bluebunch wheatgrasses, 10 percent muttongrass, 7 percent Indian ricegrass, 5 percent junegrass, 5 percent squirreltail, 5 percent Sandburg bluegrass, and 5 percent other grasses. Onion, paintbrush, milkvetch, buckwheat, and phlox are important forbs; each makes up 3 percent of the community, and other forbs make up 5 percent. The community is also 10 percent big sagebrush, 5 percent serviceberry, 5 percent Douglas rabbitbrush, and 3 percent other shrubs.

This site is suitable for grazing, but because of low production, rapid runoff, and severe hazard of erosion, careful management is necessary. Excessive grazing by cattle deteriorates the vegetation; bluebunch wheatgrass, Indian ricegrass, and junegrass decrease and such plants as western wheatgrass, squirreltail, Sandberg bluegrass, Douglas rabbitbrush, big sagebrush, and forbs that are less palatable to cattle increase.

The vegetation can be maintained by use of planned grazing systems and proper grazing practices. Improvement of the vegetation is difficult. If vegetation is in poor condition and the soils are eroding, grazing should be deferred; improvement on such areas is very slow. Range seeding is difficult but may be practical in some areas.

The estimated total annual production of air-dry plant material ranges from 200 pounds per acre in poor years to 800 pounds per acre in good years. About 100 to 500 pounds per acre is suitable forage for cattle.

Sandy Bench range site

This range site is moderate in extent. It is on the east side of the park next to the mountains. This site consists of deep well drained to somewhat excessively drained soils. The surface layer is coarse textured or moderately coarse textured. Slope ranges from 1 to 10 percent. Permeability is rapid, and available water capacity is low. Winter is extremely cold, and summer is cool. Annual precipitation is 12 to 15 inches; about one-half of this falls during the growing season. Permeability, texture, and available water capacity

strongly influence the kind and amount of vegetation on this site.

The potential plant community is 15 percent wheatgrasses, 10 percent plains reedgrass, 10 percent muttongrass, 5 percent Sandberg bluegrass, 5 percent squirreltail, 5 percent needleandthread, 5 percent Indian ricegrass, 5 percent junegrass, 5 percent blue grama, and 5 percent other grasses. Penstemon and pussytoes each make up 3 percent of the community, buckwheat and aster each make up 2 percent, and other forbs make up 5 percent. Also in the community are 10 percent big sagebrush, 5 percent serviceberry, and 5 percent other shrubs.

On this site the hazard of soil blowing is severe; blowouts can develop if the vegetation is depleted. Excessive grazing by cattle usually causes needleandthread, bluebunch wheatgrass, muttongrass, Indian ricegrass, and junegrass to decrease and big sagebrush, rhizomatous wheatgrasses, tall rabbitbrush, Douglas rabbitbrush, and forbs that are less palatable to cattle to increase.

Use of planned grazing systems and proper grazing practices maintain or improve the vegetation on this site. Because of texture, permeability, and available water capacity, range seeding is difficult and would expose the soil to blowing. Some forms of brush management, but not mechanical, are practical in some places where there is a reasonable understory of climax plants.

The estimated total annual production of air-dry plant material ranges from 500 pounds per acre in poor years to 1,200 pounds per acre in good years. About 300 to 700 pounds per acre is suitable forage for livestock.

Salt Flats range site

This range site is moderate in extent. It is on flood plains and adjacent to drainageways. This site consists of deep, well drained or moderately well drained soils that are affected by sodium salts (fig. 14). The thin surface layer is moderately coarse textured. Slope ranges from 0 to 5 percent. Permeability is slow, and available water capacity is moderate. The soils receive runoff from adjacent slopes. Winter is extremely cold, and summer is moderately cool. Annual precipitation is 10 to 12 inches; about three-fourths of this falls during the growing season. The sodium influences the kind and amount of vegetation on this site.

The potential plant community is 25 percent western wheatgrass, 20 percent saltgrass, 5 percent Indian ricegrass, 5 percent alkali bluegrass, 5 percent alkaligrass, and 5 percent other grasses. Forbs are not abundant on this site; they make up 10 percent. The site is also 10 percent greasewood, 5 percent winterfat, 5 percent mat saltbrush, and 5 percent other shrubs.

This site is suitable for grazing. Excessive grazing causes the vegetation to deteriorate; such plants as Indian ricegrass, winterfat, and alkali bluegrass decrease and western wheatgrass, alkaligrass, saltgrass, and greasewood increase.

Range vegetation can be maintained or improved by proper grazing practices and use of a planned grazing system.

The estimated total annual production of air-dry

Figure 14.—**Area of Spicerton sandy loam in Salt Flats range site. Bare areas are called "slick spots."**

plant material ranges from 500 pounds per acre in poor years to 900 pounds per acre in good years. About 400 to 700 pounds per acre is suitable forage for cattle.

Alkaline Slopes range site

This range site is limited in extent. It consists of well drained soils that are 20 to 40 inches deep over shale. The surface layer is moderately fine textured. Slope ranges from 2 to 10 percent. Permeability is slow, and available water capacity is low. Winter is extremely cold, and summer is moderately cool and dry. Annual precipitation is 10 to 12 inches; about three-fourths of this falls during the growing season. Texture and precipitation influence the kind and amount of vegetation on this site.

The potential plant community is 15 percent wheatgrass, 10 percent saltgrass, 10 percent Indian ricegrass, 10 percent squirreltail, 5 percent pine needlegrass, 5 percent bluegrasses, and 10 percent other grasses. Phlox, buckwheat, and other forbs make up 5 percent of the community. The community is also 15 percent big sagebrush, 10 percent greasewood, and 5 percent winterfat, mat saltbush, fringed sage, and other shrubs.

Excessive grazing by cattle causes Indian ricegrass, bluebunch wheatgrass, and pine needlegrass to decrease and rhizomatous wheatgrasses, Sandberg bluegrass, squirreltail, forbs, big sagebrush, and greasewood to increase. If the vegetation is in poor condition, there is a hazard of gully erosion.

Where needed, planned grazing systems, proper grazing practices, fencing, and brush management can improve the condition of range vegetation and increase forage production.

The estimated total annual production of air-dry plant material ranges from 300 pounds per acre in poor years to 700 pounds per acre in good years. About 150 to 450 pounds per acre is suitable forage for livestock.

Claypan range site

This range site is limited in extent. It is in small areas. This site consists of well drained or moderately well drained soils that are deep or moderately deep over shale. The surface layer is medium textured or fine textured. Slope ranges from 3 to 15 percent. Permeability is moderately slow or slow, and available water capacity is low to high. Winter is extremely cold, and summer is cool. Annual precipitation is 10 to 16 inches; about two-thirds of this falls during the growing season. The fine-textured subsoil and high shrink-swell potential influence the kind and amount of vegetation on this site.

This site is dominated by shallow-rooted plants. The potential plant community is 15 percent streambank wheatgrass, 10 percent junegrass, 10 percent muttongrass, 5 percent bluebunch wheatgrass, and 6 percent other grasses. Aster, sedum, and pussytoes each make up 2 percent of the community; and bluebells, low larkspur, buckwheat, phlox, penstemon, onion, and other forbs make up 5 percent. The community is also 30 percent alkali sagebrush, 5 percent mat saltbush, 5 percent winterfat, and 3 percent other shrubs.

Excessive grazing by cattle causes bluebunch wheatgrass, junegrass, and muttongrass to decrease and streambank wheatgrass, forbs, and alkali sagebrush to increase. If the vegetation is low and in fair or poor condition, such plants as greasewood and tall rabbitbrush invade.

Proper grazing practices and a planned grazing system can maintain or improve range vegetation.

The estimated total annual production of air-dry plant material ranges from 300 pounds per acre in poor years to 800 pounds per acre in good years. About 200 to 650 pounds per acre is suitable forage for livestock.

Deep Clay Loam range site

This range site is limited in extent. It consists of deep, well drained soils. The surface layer is medium textured. Slope ranges from 5 to 15 percent. Permeability is slow, and available water capacity is high. Winter is extremely cold, and summer is cool. Annual precipitation is 18 to 20 inches; slightly more than one-half of this falls during the growing season. The thick, fine-textured subsoil influences the kind and amount of vegetation on this site.

The potential plant community is 15 percent wheatgrasses, 10 percent Idaho fescue, 10 percent Thurber fescue, 5 percent muttongrass, 5 percent Indian ricegrass, 5 percent junegrass, and 5 percent squirreltail, Sandberg bluegrass, and other grasses. The community is also 3 percent aspen peavine, 2 percent fleabane, 2 percent buckwheat, and 7 percent wyethia, yarrow, balsamroot, lupine, phlox, geranium, paintbrush, aster, sneezeweed, green gentian, oregongrape, milkvetches, and other forbs. Big sagebrush and silver sagebrush make up 10 percent of the community; and the community is 8 percent serviceberry, 5 percent snowberry, 3 percent rose, and 5 percent low rabbitbrush and other shrubs.

Excessive grazing by cattle causes bluebunch wheatgrass, muttongrass, slender wheatgrass, Idaho fescue, Thurber fescue, Indian ricegrass, and junegrass to decrease and less palatable western wheatgrass, squirreltail, Sandberg bluegrass, shrubs, and forbs to increase.

Vegetation responds to use of proper grazing practices and planned grazing systems. Brush management is practical where there is an excess of shrubs and a sufficient understory of potential grasses and forbs. Clearing and seeding to suited plants is necessary in some places where vegetation is in poor condition.

The estimated total annual production of air-dry plant material ranges from 1,500 pounds per acre in poor years to 2,500 pounds per acre in good years. About 1,200 to 2,000 pounds per acre is suitable forage for cattle.

Subalpine Loam range site

This range site is limited in extent. It forms open parks in the spruce-fir zone (fig. 15). This site consists of deep, well drained soils. The surface layer is medium textured. Slope ranges from 0 to 20 percent. Permeability is slow, and available water capacity is high. Winter is extremely cold, and summer is cool. Annual precipitation is 18 to 24 inches; slightly more than one-half of this falls during the growing season. The short growing season, permeability, and moderately fine textured or fine-textured subsoil influence the kind and amount of vegetation on this site.

Figure 15.—**Subalpine Loam range site has dense cover of high-producing grasses and silver sagebrush; Gothic loam.**

The potential plant community is 15 percent Thurber fescue, 10 percent Idaho fescue, 10 percent wheatgrasses, 5 percent native bromes, 5 percent needlegrasses, 5 percent bluegrasses, 5 percent junegrass, 5 percent squirreltail, and 5 percent oniongrass, spike trisetum, Parry oatgrass, sheep fescue, mountain muhly, and other grasses. The community is also 5 percent aspen peavine, 3 percent lupine, 3 percent penstemon, 2 percent fleabane, 2 percent phlox, and 5 percent geranium, yarrow, iris, meadow rue, tall larkspur, buckwheat, orange sneezeweed, Gunnison lily, clovers, and other forbs. Silver sagebrush and big sagebrush make up 10 percent of the community, snowberry makes up 3 percent, and shrubby cinquefoil makes up 2 percent; fringed sage is also found on this site.

Heavy grazing by cattle causes Thurber fescue, nodding brome, big bluegrass, bearded wheatgrass, Idaho fescue, oniongrass, spike trisetum, and Parry oatgrass to decrease and less palatable plants to increase. If the vegetation deteriorates to poor condition, such plants as tall rabbitbrush, low rabbitbrush, and Douglas knotweed invade.

The vegetation on this site may deteriorate if grazed early in spring. Use of a planned grazing system and proper grazing practices help to maintain or improve vegetation. If there is a sufficient understory of potential plants and an excess of brush plants, brush management is suitable. Range seeding is beneficial in some places where vegetation is in poor condition. Because the season of use on this site is short, the cost of these measures may not be worth the benefits.

The estimated total annual production of air-dry plant material ranges from 2,000 pounds per acre in poor years to 4,000 pounds per acre in good years. About 1,600 to 3,200 pounds per acre is suitable forage for livestock.

Alpine Slopes range site

This range site is limited in extent. It is above timberline on high mountainsides. This site consists of moderately deep, well drained soils. The surface layer is moderately coarse textured and gravelly. Slope ranges from 10 to 40 percent. Permeability is moderately rapid, and available water capacity is low. Winter is extremely cold, and summer is cool. Annual precipitation is 20 to 26 inches; about one-third of this falls during the growing season. The high elevation and extremely short growing season influence the kind and amount of vegetation on this site.

The potential plant community is 15 percent tufted hairgrass, 10 percent alpine bluegrass and Arctic bluegrass, 10 percent sedges, 5 percent Scribner and Baker wheatgrasses, and 5 percent other grasses. The community is also 30 percent kobresia, 5 percent American bistort, 5 percent alpine sagebrush, and 15 percent alpine bluebells, yarrow, herbaceous cinquefoil, willows, fleabane, penstemon, pussytoes, tufted phlox, alpine clover, and other forbs.

The potential vegetation on this site is extremely fragile, especially early in spring. Heavy grazing by sheep causes alpine bluegrass, Scribner wheatgrass, Baker wheatgrass, alpine clover, Arctic bluegrass, and tufted hairgrass to decrease and kobresia, shrubs, and

forbs that are less palatable to sheep to increase. There is a severe hazard of erosion.

Sheep should not be repeatedly trailed across this site.

The estimated total annual production of air-dry plant material ranges from 500 pounds per acre in poor years to 1,000 pounds per acre in good years. No more than 300 pounds per acre is suitable forage for livestock.

Stony Loam range site

This range site is very limited in extent. It consists of deep, well drained, stone-filled soils on hillsides. The surface layer is extremely stony and moderately coarse textured. Slopes ranges from 20 to 40 percent. Permeability is rapid, and available water capacity is low. Winter is extremely cold, and summer is cool. Annual precipitation is 16 to 20 inches; about one-half of this falls during the growing season. The large amount of stones and the permeability influence the kind and amount of vegetation on this site.

The potential plant community is 10 percent bluebunch wheatgrass, 5 percent western wheatgrass, 5 percent Indian ricegrass, 5 percent muttongrass, 5 percent mountain muhly, 5 percent needlegrasses, 5 percent nodding brome, and 10 percent sedges, junegrass, spike fescue, Sandberg bluegrass, and other grasses. The community is also 3 percent penstemon, 2 percent paintbrush, 2 percent buckwheat, and 5 percent clover, balsamroot, loco, fleabane, phlox, lupine, bluebells, pussytoes, and other forbs. The community is also 12 percent serviceberry, 10 percent big sagebrush, 10 percent snowberry, 3 percent bitterbrush, and 3 percent low rabbitbrush and other shrubs.

Excessive grazing by cattle causes bluebunch wheatgrass, Indian ricegrass, mountain muhly, nodding brome, and pine needlegrass to decrease and such plants as junegrass and western wheatgrass, as well as forbs and shrubs that are less palatable to cattle, to increase.

On depleted range where there is an excess of brush and a sufficient understory of potential plants, brush control helps to improve the vegetation. Proper grazing practices and use of planned grazing systems maintain or improve the vegetation.

The estimated total annual production of air-dry plant material ranges from 1,000 pounds per acre in poor years to 2,000 pounds per acre in good years. About 600 to 1,200 pounds per acre is suitable forage for livestock.

Wildlife[4]

Jackson County Area has a wide variety of wildlife habitat. Wildlife include year-round residents and migratory species. Some migratory species, such as the cinnamon teal and western tanager, use the Area temporarily during spring, summer, and fall and spend winter in the south.

Important animals are mule deer, elk, black bear, pronghorn, sage grouse, blue grouse, ptarmigan, ducks (principally mallard, widgeon, and gadwall), and Canada geese. Nongame animals are abundant. The principal fish in the Area are cold-water species. The many streams, rivers, and lakes provide good to excellent trout fishing.

The condition of wildlife habitat in Jackson County Area is largely controlled by man and his activities.

The basic requirements of wildlife are food, cover, and water. Soils directly influence the kind and amount of vegetation and amount of water available and through them influence the kinds of wildlife that can live in an area. Wildlife species and populations are managed principally through the manipulation of soil, water, and plants. Knowing the properties of kinds of soil and their relationship to plants makes it possible to predict how soils will behave under alternative plant and water management systems. Thus, meaningful wildlife interpretations and management decisions can be made on the basis of soils information. Soil properties that affect the growth of wildlife habitat are thickness of soil useful to plants, surface texture, available water capacity, wetness, surface stoniness or rockiness, hazard of flooding, slope, and permeability.

In table 6 soils of Jackson County Area are rated for their capacity to produce eight elements of wildlife habitat and four kinds of wildlife. The ratings indicate relative suitability for various elements and are expressed by adjectives as follows:

Good means habitat is easily improved, maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected.

Fair means habitat can be improved, maintained, or created on these soils, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required to ensure satisfactory results.

Poor means habitat can be improved, maintained, or created on these soils, but the soil limitations are severe. Habitat management may be difficult and expensive and may require intensive effort. Results are questionable.

Very poor means that under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account present use of the soil or present distribution of wildlife and people, nor is possible influence on habitat by adjoining areas considered. Some influences on habitat, such as elevation and aspect, must be appraised onsite.

Each soil is rated in table 6 according to its suitability for producing various kinds of plants and other elements that make up wildlife habitat.

Grain and seed crops are annual grain-producing plants such as wheat, barley, and oats. The growing season in Jackson County Area is too short for full maturity of these crops.

Grasses and legumes are established by planting. They provide food and cover for wildlife. Grasses include Garrison creeping foxtail, timothy, crested wheat-

[4] JOHN A. DIMAS, wildlife biologist, Soil Conservation Service, helped to prepare this section.

grass, and panicgrass. Legumes include yellow sweetclover and alsike clover.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland, woodland, and rangeland wildlife. Typical plants are sheep fescue, Idaho fescue, bluebunch wheatgrass, and perennial forbs and legumes such as buckwheat, herbaceous cinquefoil, elk sedge, and low rabbitbrush.

Coniferous plants are cone-bearing trees and shrubs that provide cover and frequently food in the form of browse, seeds, or fruitlike cones. Typical plants in this category are lodgepole pine, alpine fir, Englemann spruce, aspen (not a conifer but included under this heading), and ornamental trees and shrubs.

Shrubs produce buds, twigs, bark, or foliage used as food by wildlife, or they provide cover and shade for some wildlife species. Typical plants in this category are bitterbrush, rabbitbrush, big sagebrush, and serviceberry.

Wetland plants include annual and perennial herbaceous plants that grow on moist and wet sites. They mostly furnish food and cover for wetland wildlife. Typical plants are rushes, sedges, and burreed. Submerged and floating aquatics are not included in this category.

Shallow water areas are areas of surface water useful to wildlife. The average depth is less than 5 feet. They may be natural wet areas or may be created by dams or levees or by water-control devices in marshes or streams. Typical examples are waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

Each soil is also rated in table 6 according to its suitability for the four kinds of wildlife in the Area. These ratings are related to ratings made for the elements of habitat. For example, soils rated as *very poor* for shallow water developments are rated *very poor* for wetland wildlife.

Openland wildlife consists of birds and mammals of croplands, pasture, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are meadowlark, field sparrow, killdeer, cottontail rabbit, and red fox.

Woodland wildlife consists of birds and mammals of wooded areas containing either hardwood or coniferous trees and shrubs or a mixture of both. Examples are blue grouse, vireos, woodpeckers, red squirrel, coyote, red fox, raccoon, mule deer, elk, and black bear.

Wetland wildlife consists of birds and mammals of swampy, marshy, or open-water areas. Examples are ducks, geese, herons, shore birds, rails, greater sandhill cranes, kingfishers, muskrat, mink, and beaver.

Rangeland wildlife consists of birds and mammals of natural range. Examples are pronghorn antelope, mule deer, white-tailed prairie dog, Wyoming ground squirrel, sage grouse, and meadowlark.

Recreation

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 7 the soils of Jackson County Area are rated according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer.

Not considered in these ratings, but important in evaluating a site, are size and shape of the area, its scenic quality, the ability of the soil to support vegetation, access to water, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreational use by the duration and season of flooding. Onsite assessment of height, duration, and frequency of flooding is essential in planning recreational facilities.

In table 7 the limitations of soils are rated as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, or a combination of these measures.

Camp areas require such site preparation as shaping and leveling areas for tents and parking, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have slopes of 0 to 8 percent and are not wet or subject to flooding during the period of use. The surface is free of stones and boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of leveling a site.

Picnic areas are subject to heavy foot traffic, but most vehicular traffic is confined to access roads. The best soils for use as picnic areas are firm when wet but not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping and leveling sites or of building access roads and parking lots.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are nearly level and are not wet or subject to flooding during the season of use. The surface is free of gravel, stones, and boulders, is firm after rains, and is not dusty when dry. If leveling is required to obtain a uniform grade, the depth of the soil over bedrock should be sufficient to allow necessary grading.

The design and layout of foot *paths* and horseback *trails* should require little or no cutting and filling. The best soils for this use are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

The information in table 7 can be supplemented by additional information in other parts of this survey. Especially helpful are the interpretations for septic tank absorption fields given in table 11 and the interpretations for dwellings without basements and for local roads and streets given in table 12.

TABLE 6.—*Wildlife*

[See text for definitions of "good," "fair," "poor," and "very poor."

Soil name and map symbol	Potential for habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs
Aaberg:					
Ab[1]:					
Aaberg part	Poor	Poor	Fair		Fair
Barishman part	Poor	Poor	Fair		Fair
Agneston:					
Ag	Poor	Poor	Good	Fair	Fair
Badland:					
Ba.					
Not rated.					
Bangston:					
Bg	Poor	Poor	Fair	Poor	Fair
Blackwell:					
Bk	Poor	Poor	Fair		Fair
Blevinton:					
Bn	Poor	Poor	Good		Fair
Boettcher:					
Bo[1]:					
Boettcher part	Poor	Poor	Fair		Fair
Bundyman part	Poor	Poor	Fair		Fair
Bosler:					
Bs	Poor	Fair	Fair		Fair
Bowen:					
Bw	Very poor	Very poor	Fair		Fair
Brinkert:					
Bx[1]:					
Brinkert part	Poor	Fair	Fair		Fair
Morset part	Poor	Fair	Fair		Fair
Buffmeyer:					
By	Poor	Fair	Fair		Fair
Cabin:					
Ca	Poor	Poor	Good		Fair
Chedsey:					
Cd	Poor	Poor	Good		Fair
Coalmont:					
Cf[1]:					
Coalmont part	Poor	Poor	Fair		Fair
Fluetsch part	Poor	Poor	Fair		Fair
Cowdrey:					
CoD	Poor	Poor	Good	Good	Fair
CoF	Very poor	Very poor	Good	Good	Fair
Crespin:					
Cr, Cs[1]:					
Crespin parts	Poor	Poor	Fair		Fair
Carlstrom parts	Poor	Poor	Fair		Fair
Cryaquents:					
Ct	Very poor	Very poor	Fair		Fair

habitat potentials

Absence of an entry indicates the soil was not rated]

Potential for habitat elements—Cont.		Potential as habitat for—			
Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Fair	Fair	Very poor	Fair.
Very poor	Very poor	Poor	Poor	Very poor	Fair.
Good	Good	Poor		Good	Fair.
Poor	Very poor	Fair		Very poor	Fair.
Poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair	Poor	Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Poor	Fair	Very poor	
Poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Good	Good	Poor		Good	Fair.

TABLE 6.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs
Cryorthents: CyF	Very poor	Very poor	Poor		Poor
Dobrow: Do	Very poor	Poor	Poor		Fair
Dune land: Du. Not rated.					
Eachuston: Ea	Poor	Poor	Good		Fair
Ethelman: EhE	Poor	Fair	Good		Fair
Fleer: Fe	Poor	Poor	Fair		Fair
Fluetsch: Fh[1]:					
Fluetsch part	Poor	Poor	Fair		Fair
Tiagos part	Poor	Poor	Fair		Fair
Forelle: Fo	Poor	Fair	Fair		Fair
Gelkie: GeD	Poor	Fair	Fair		Fair
Gelkie variant: GkE	Poor	Poor	Good		Fair
Girardot: Gn	Very poor	Poor	Poor		Fair
Gothic: GoE	Poor	Fair	Fair		Fair
Grafen: Gr[1]:					
Grafen part	Very poor	Very poor	Fair		Fair
Rock outcrop part not rated.					
Grimstone: Gs[1]:					
Grimstone part	Poor	Poor	Good	Good	Fair
Siebert part	Poor	Poor	Good	Fair	Fair
Handran: HaF	Very poor	Very poor	Fair		Fair
Kather: KsE	Poor	Poor	Fair		Fair
Larand: LaE, LaF	Very poor	Very poor	Good	Good	Fair
Leavitt: Le	Poor	Fair	Fair		Fair
Lulude: LuE	Very poor	Very poor	Good	Fair	Fair
Lymanson: LyD	Poor	Fair	Good		Fair

potentials—Continued

Potential for habitat elements—Cont.		Potential as habitat for—			
Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Very poor	Very poor	Very poor		Very poor	Poor.
Good	Good	Poor		Good	Poor.
Good	Good	Poor		Good	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Good	Good	Poor		Good	Fair.
Poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Good	Good	Poor		Good	Poor.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Fair	Fair	Very poor	
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Fair	Fair	Very poor	
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Fair		Very poor	Fair.

TABLE 6.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs
MacFarlane:					
Ma[1]:					
MacFarlane part	Very poor	Very poor	Good	Fair	Fair
Rock outcrop part not rated.					
Manburn:					
MbF	Very poor	Very poor	Fair		Fair
Mendenhall:					
Me	Poor	Poor	Fair		Fair
Mine pits and dumps:					
Mn.					
Not rated.					
Mirror:					
Mo[1]:					
Mirror part	Very poor	Very poor	Fair		Fair
Rock outcrop part not rated.					
Mord:					
MrD	Poor	Poor	Good		Fair
Morset:					
MsD	Poor	Fair	Fair		Fair
Muggins:					
MuE	Poor	Poor	Fair	Good	Fair
Nokhu:					
NoE	Poor	Poor	Good	Good	Fair
NoF	Very poor	Very poor	Good	Good	Fair
Norriston:					
Nr	Poor	Poor	Fair		Fair
Owen Creek:					
Oc	Poor	Fair	Fair		Fair
On[1]:					
Owen Creek part	Poor	Fair	Fair		Fair
Norriston part	Poor	Poor	Fair		Fair
Parkview:					
PaF	Very poor	Very poor	Fair		Fair
Peeler:					
PeE	Poor	Poor	Good	Good	Fair
PeF	Very poor	Very poor	Good	Good	Fair
Perceton:					
Ph[1]:					
Perceton part	Poor	Poor	Good	Good	Fair
Hyannis part	Poor	Poor	Fair	Poor	Fair
Pinkham:					
Pr[1]:					
Pinkham part	Very poor	Very poor	Good	Good	Fair
Rock outcrop part not rated.					
Randman:					
Ra	Very poor	Poor	Good		Fair

potentials—Continued

Potential for habitat elements—Cont.		Potential as habitat for—			
Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Poor		Very poor	Fair.
Good	Very poor	Poor		Poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Poor	Good	Very poor	
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor	Good	Very poor	
Very poor	Very poor	Poor	Good	Very poor	
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Fair	Fair	Very poor	
Very poor	Very poor	Poor	Good	Very poor	
Good	Good	Poor		Good	Fair.

TABLE 6.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs
Rawah: RhD	Poor	Poor	Fair		Fair
Rock land: Rk. Not rated.					
Rock outcrop: Ro. Not rated.					
Rogert: RtE	Very poor	Very poor	Poor		Fair
Spicerton: Sp	Very poor	Very poor	Very poor		Poor
Stumpp: St	Very poor	Very poor	Poor		Poor
Sudduth: SuE	Poor	Poor	Good		Fair
Tealson: Te[1]: Tealson part	Very poor	Very poor	Poor		Fair
Rock land part not rated.					
Tine: Tn	Poor	Poor	Fair		Fair
Troutville: ToF	Very poor	Very poor	Good	Fair	Fair
Tv[1]: Troutville part	Poor	Poor	Good	Fair	Fair
Newcomb part	Poor	Poor	Fair	Fair	Fair
Walden: Wa	Poor	Poor	Good		Fair
Wichup: Wc	Very poor	Very poor	Fair		Fair
Yochum: YoF	Very poor	Very poor	Fair	Poor	Fair

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior

Engineering uses of the soils [5]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and ranchers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who–

1. Select potential residential, industrial, commercial, and recreational areas.

[5] FLOYD KELLY, JR., engineer, Soil Conservation Service, helped to prepare this section.

potentials—Continued

Potential for habitat elements—Cont.		Potential as habitat for—			
Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Fair	Poor		Fair	Poor.
Poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Fair	Fair	Very poor	
Very poor	Very poor	Poor	Fair	Very poor	
Good	Good	Fair		Good	Fair.
Good	Good	Poor		Good	Fair.
Very poor	Very poor	Very poor	Poor	Very poor	

of the whole mapping unit.

2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for for controlling water and conserving soil.
5. Correlate performance or structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 8 through 14, which show estimates of several soil properties significant to engineering and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 11

TABLE 7.—*Recreation*

["Percs slowly" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Aaberg: Ab[1]: Aaberg part	Severe: too clayey	Severe: too clayey	Severe: too clayey, slope.	Severe: too clayey.
Barishman part	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
Agneston: Ag	Severe: slope	Severe: slope	Severe: small stones, slope.	Moderate: small stones, slope.
Badland. Ba.				
Bangston: Bg	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy, slope.	Moderate: too sandy.
Blackwell: Bk	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Blevinton: Bn	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Boettcher: Bo[1]: Boettcher part	Moderate: too clayey	Moderate: too clayey	Severe: slope	Moderate: too clayey.
Bundyman part	Moderate: percs slowly, too clayey.	Moderate: too clayey	Moderate: percs slowly, too clayey, slope.	Moderate: too clayey.
Bosler: Bs	Slight	Slight	Moderate: slope	Slight.
Bowen: Bw	Severe: slope	Severe: slope	Severe: small stones, slope.	Severe: slope.
Brinkert: Bx[1]: Brinkert part	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
Morset part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Buffmeyer: By	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Cabin: Ca	Slight	Slight	Moderate: slope, small stones.	Slight.
Chedsey: Cd	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
Coalmont: Cf[1]: Coalmont part	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
Fluetsch part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Cowdrey: CoD	Moderate: percs slowly.	Slight	Severe: slope	Slight.
CoF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

TABLE 7.—*Recreation*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Crespin:				
Cr, Cs[1]:				
Crespin parts	Severe: too clayey	Severe: too clayey	Severe: too clayey, slope.	Severe: too clayey.
Carlstrom parts	Severe: too clayey, percs slowly.	Severe: too clayey	Severe: percs slowly, too clayey, slope.	Severe: too clayey.
Cryaquents:				
Ct	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Cryorthents:				
CyF	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Dobrow:				
Do	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Dune land:				
Du.				
Not rated.				
Eachuston:				
Ea	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness.
Ethelman:				
EhE	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Fleer:				
Fe	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness.
Fluetsch:				
Fh[1]:				
Fluetsch part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Tiagos part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Forelle:				
Fo	Slight	Slight	Moderate: slope	Slight.
Gelkie:				
GeD	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Gelkie variant:				
GkE	Moderate: small stones, slope.	Moderate: small, stones, slope.	Severe: small stones, slope.	Moderate: small stones.
Girardot:				
Gn	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness.
Gothic:				
GoE	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
Grafen:				
Gr[1]:				
Grafen part	Severe: slope, large stones.	Severe: slope	Severe: slope, large stones.	Severe: slope.
Rock outcrop part not rated.				
Grimstone:				
Gs[1]:				
Grimstone part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Siebert part	Severe: slope	Severe: slope	Severe: small stones, slope.	Moderate: too sandy, small stones, slope.

TABLE 7.—*Recreation*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Handran: HaF	Severe: large stones, slope.	Severe: slope	Severe: slope, large stones.	Severe: large stones, slope.
Kather: KaE	Moderate: too clayey, percs slowly, slope.	Moderate: too clayey	Severe: slope	Moderate: too clayey.
Larand: LaE	Moderate: slope	Moderate: slope	Severe: slope	Slight.
LaF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Leavitt: Le	Slight	Slight	Moderate: slope	Slight.
Lulude: LuE	Severe: slope	Severe: slope	Severe: large stones, slope.	Moderate: large stones, slope.
Lymanson: LyD	Moderate: small stones.	Moderate: small stones.	Severe: small stones, slope.	Moderate: small stones.
MacFarlane: Ma[1]: MacFarlane part	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.
Rock outcrop part not rated.				
Manburn: MbF	Severe: slope	Severe: slope	Severe: depth to rock, slope, small stones.	Severe: slope.
Mendenhall: Me	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Mine pits and dumps: Mn. Not rated.				
Mirror: Mo[1]: Mirror part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Rock outcrop part not rated.				
Mord: MrD	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
Morset: MsD	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Muggins: MuE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Nokhu: NoE	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
NoF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Norriston: Nr	Slight	Slight	Severe: small stones	Slight.
Owen Creek: Oc	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly, depth to rock.	Slight.

TABLE 7.—*Recreation*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Owen Creek: Or[1]: Owen Creek part	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly, depth to rock.	Slight.
Norriston part	Moderate: slope	Moderate: slope	Severe: small stones, slope.	Slight.
Parkview: PaF	Severe: large stones, slope.	Severe: large stones	Severe: large stones, slope.	Severe: large stones, slope.
Peeler: PeE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
PeF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Perceton: Ph[1]: Perceton part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope
Hyannis part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Pinkham: Pr[1]: Pinkham part	Severe: slope, large stones.	Severe: slope	Severe: slope, large stones.	Severe: slope, large stones.
Rock outcrop part not rated.				
Randman: Ra	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Rawah: RhD	Slight	Slight	Severe: slope	Slight.
Rock land: Rk. Not rated.				
Rock outcrop: Ro. Not rated.				
Rogert: RtE	Severe: slope	Severe: slope	Severe: slope, small stones.	Moderate: small stones, slope.
Spicerton: Sp	Moderate: dusty, percs slowly, floods.	Moderate: dusty, floods.	Severe: floods	Moderate: dusty.
Stumpp: St	Moderate: floods, percs slowly, wetness.	Moderate: floods, wetness.	Severe: floods	Moderate: dusty.
Sudduth: SuE	Moderate: percs slowly, slope.	Moderate: slope	Severe: slope	Slight.
Tealson: Te[1]: Tealson part	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Moderate: slope.
Rock land part not rated.				
Tine: Tn	Slight	Slight	Moderate: slope	Slight.

TABLE 7.—*Recreation*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Troutville: ToF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Tv[1]:				
Troutville part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Newcomb part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Walden:				
Wa	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Wichup:				
Wc	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Yochum:				
YoF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

through 14, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavation to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have different meanings in soil science and in engineering; the Glossary defines many of these terms as they are used in soil science.

Soil properties significant to engineering

Estimates of several soil properties significant to engineering are given in tables 8, 9, and 10. The estimates in tables 8 and 9 are made for representative soil profiles, by layers sufficiently different to have different significance for soil engineering. All of the estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other areas.

Table 8 shows estimates of several engineering properties and classifications of the soils.

USDA Texture is described in table 8 in standard terms used by the United States Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified soil classification system and the American Association of State Highway and Transportation Officials (AASHTO) soil classification system. In table 8 soils in the survey area are classified according to both systems (*4*).

The Unified system classifies soils according to properties that affect their use as construction material (*2*). Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example CL-ML.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance (*1*). In this system a mineral soil is classified as one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A–1 are coarse grained and low in content of fines. At the other extreme, in group A–7, are fine-grained soils. Highly organic soils are classified as A–8 on the basis of visual inspection.

Also in table 8 the percentage, by weight, of cobbles, the rock *fragments more than 3 inches* in diameter, is estimated for each major horizon. These estimates are determined largely by observing percentage by volume in the field and then converting it to percentage by weight.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect

of water on the strength and consistency of soil. These indexes are used in both the Unified and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

Table 9 shows estimates of several soil characteristics and features that affect behavior of soils in engineering uses.

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field—particularly structure, porosity, and gradation of texture—that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, texture, and structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization, and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is largely affected by the quality of the irrigation water and the irrigation practices. Hence, the salinity of individual fields can differ greatly from the value given in table 9. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil (fig. 16). Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A *high* shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

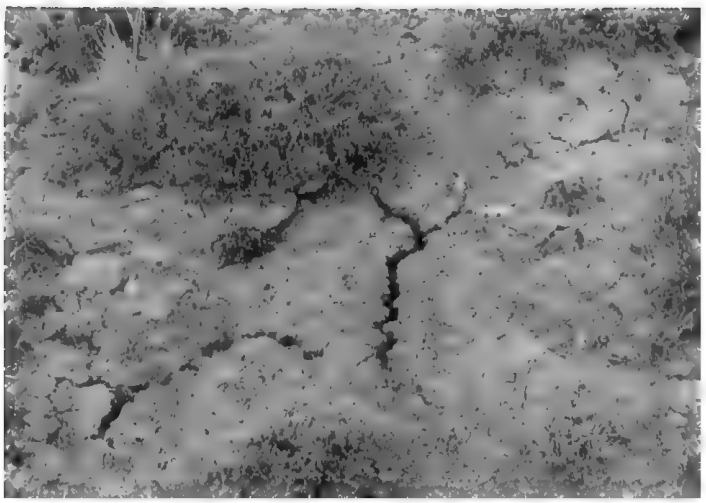

***Figure 16.*—Extremely wide cracks form in Aaberg clay when the soil dries out.**

Risk of corrosion, as used in table 9, pertains to potential soil induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

Erosion factors are used in an equation that predicts the amount of erosion resulting from certain land treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to detachment and transport by rainfall. Soils having the highest numbers are the most erodible. The soil-loss tolerance factor (T) is the relative maximum rate of soil erosion, whether from rainfall or wind, that may occur without causing reduced levels of crop production or environmental quality. The T factor is estimated for the whole soil.

Features that relate to runoff or infiltration of water, to flooding, to grading and excavation, and to frost action of each soil are indicated in table 10.

Hydrologic group is used to estimate runoff after rainfall. Soil properties that influence the minimum rate of infiltration into the bare soil after prolonged wetting are depth to a water table, water intake rate and permeability after prolonged wetting, and depth to layers of slowly permeable or very slowly permeable soil.

Flooding is rated in general terms that describe the frequency and duration of flooding and the period of the year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of

TABLE 8.—*Engineering properties*

[The symbol > means greater than Absence

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Aaberg:				
Ab[1]:				
Aaberg part	0–4	Clay	CL, CH	A–7
	4–30	Clay, clay loam	CL, CH	A–7
	30	Weathered bedrock		
Barishman part	0–12	Loam	ML, ML–CL	A–4
	12–60	Clay	CH, CL	A–7
Agneston:				
Ag	0–6	Gravelly coarse sandy loam	GM, SM	A–1
	6–25	Very gravelly sandy clay loam, gravelly sandy clay loam.	GC, GP–GC	A–2
	25	Unweathered bedrock.		
Badland:				
Ba.				
Not estimated.				
Bangston:				
Bg	0–26	Fine sand	SM	A–1, A–2
	26–60	Loamy sand, sand	SP–SM, SM	A–1, A–2, A–3
Blackwell:				
Bk	0–13	Loam	CL–ML, CL	A–4, A–6
	13–46	Sandy clay loam	SC–SM, SC, CL	A–2, A–4
	46–60	Very gravelly sand	GP, GW	A–1
Blevinton:				
Bn	0–8	Sandy loam	SM, ML, CL–ML	A–4
	8–60	Fine sandy loam	SM, ML, CL–ML	A–4
Boettcher:				
Bo[1]:				
Boettcher part	0–4	Clay loam	CL, CH	A–6
	4–29	Clay	CL, CH	A–6, A–7
	29	Unweathered bedrock, weathered bedrock.		
Bundyman part	0–4	Clay loam	CL, CH	A–6, A–7
	4–25	Clay loam, clay	CH	A–7
	25	Weathered bedrock.		
Bosler: Bs	0–3	Sandy loam	SM,SM–SC	A–4
	3–21	Sandy clay loam	SC	A–6
	31–60	Very gravelly loamy coarse sand	GP, GP–GM	A–1
Bowen:				
Bw	0–10	Gravelly sandy loam	SM, GM	A–1
	10–28	Very gravelly sandy clay loam, very gravelly sandy loam.	GM, GP–GM	A–1
	28	Unweathered bedrock.		
Brinkert:				
Bx[1]:				
Brinkert part	0–5	Loam	CL, CL–ML	A–6
	5–25	Clay loam, clay	ML	A–7
	25–60	Sandy clay loam	CL	A–6
Morset part	0–7	Loam	CH, CL	A–4, A–6
	7–18	Clay loam	SC	A–6
	18–60	Loam	ML, CL–ML	A–4
Buffmeyer:				
By	0–13	Sandy loam	CL	A–2, A–4
	13–60	Gravelly sandy loam	ML, CL–ML	A–1

and classifications

of an entry means data were not estimated]

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	90–100	75–100	70–95	60–85	40–55	20–35
0	95–100	75–100	70–95	60–85	40–55	20–35
0–5	90–100	90–100	85–95	50–65	15–30	NP–10
0–5	90–100	95–100	90–100	75–95	45–70	30–45
0–5	35–70	35–65	20–30	15–25	----------	NP
0–10	20–50	15–50	5–35	5–30	20–35	10–20
0–5	75–100	75–100	40–70	15–25	----------	NP
0–5	75–100	75–100	35–70	5–25	----------	NP
0	75–100	75–100	70–100	55–80	25–40	5–15
0–10	75–100	75–100	60–90	25–55	25–35	5–15
0	25–40	20–35	10–20	0–5	----------	NP
0–5	80–100	75–100	70–85	40–55	20–30	NP–10
0–5	80–100	75–100	70–85	40–55	20–30	NP–10
0–5	95–100	90–100	90–100	70–85	30–40	20–30
0–5	80–100	75–100	70–100	70–85	35–60	30–45
0	100	80–100	90–100	70–80	35–55	20–30
0	100	80–100	90–100	70–80	40–60	20–35
0	80–100	75–100	55–75	35–50	15–25	NP–10
0	80–100	75–100	65–85	35–50	25–35	10–20
0	25–40	20–35	10–20	0–10	----------	NP
0–10	55–75	50–75	30–50	15–25	----------	NP
0–20	25–55	20–50	15–40	10–25	15–30	NP–5
0–5	90–100	80–100	80–95	60–80	30–40	10–20
0–5	90–100	80–100	70–95	60–80	45–65	25–40
0–5	90–100	80–90	70–85	35–50	30–40	10–20
0	85–95	85–95	80–85	55–70	20–35	5–15
0	90–100	90–100	80–90	60–70	30–40	10–20
0–5	75–100	75–100	70–80	50–65	15–35	2–10
0–5	80–100	75–100	60–70	25–40	15–20	NP–4
15–35	50–65	50–60	35–40	20–25	15–20	NP–4

TABLE 8.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Cabin:				
Ca	0–4	Sandy loam	SM	A–2, A–1
	4–26	Gravelly sandy clay loam, very gravelly sandy loam.	SC, GC	A–2, A–6
	26–60	Very gravelly sand, very stony loamy sand.	GP–GM, GM	A–1
Chedsey:				
Cd	0–13	Loam	ML	A–4
	13–36	Clay loam, clay	CL, CH	A–6, A–7
	36	Weathered bedrock.		
Coalmont:				
Cf[1]:				
Coalmont part	0–4	Loam	ML, CL–ML, CL	A–4
	4–30	Clay, clay loam	CH, CL	A–7
	30	Weathered bedrock, unweathered bedrock.		
Fluetsch part	0–10	Sandy loam	SM	A–2
	10–30	Sandy clay loam	SM–SC, SC, CL–ML, CL	A–4, A–6
	30–60	Sandy loam	SM	A–2
Cowdrey:				
CoD, CoF	0–12	Loam	ML, CL–ML	A–4
	12–60	Clay, gravelly clay.	CH, GC	A–7
Crespin:				
Cr[1]:				
Crespin part	0–9	Clay	CH	A–7
	9–60	Clay, silty clay loam	CH	A–7
Carlstrom part	0–7	Clay	CH	A–7
	7–26	Clay	CH	A–7
	26	Weathered bedrock.		
Cs[1]:				
Crespin part	0–9	Stony clay	CH	A–7
	9–60	Clay, silty clay loam	CH	A–7
Carlstrom part	0–7	Stony clay	CH	A–7
	7–26	Clay, silty clay loam, silty clay	CH	A–7
	26	Weathered bedrock.		
Cryaquents:				
Ct.				
Not estimated.				
Cryorthents:				
CyF.				
Not estimated.				
Dobrow:				
Do	0–28	Loam	ML, SM	A–4
	28–60	Very gravelly sand	GP	A–1
Dune land:				
Du.				
Not estimated.				
Eachuston:				
Ea	0–8	Gravelly loam	SM, GM, ML	A–1, A–2, A–4
	8–60	Very gravelly loamy sand, very gravelly sand.	GP, GP–GM	A–1
Ethelman:				
EhE	0–7	Sandy loam	SM, ML	A–4
	7–29	Fine sandy loam, gravelly sandy loam	SM	A–2, A–4
	29	Weathered bedrock.		

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–5	75–95	75–95	30–50	15–35		NP
5–10	55–75	50–75	40–50	25–45	20–35	10–15
10–50	30–50	30–50	15–25	5–15		NP
0–5	80–100	80–100	80–95	55–70	25–35	NP–10
0	85–100	85–100	85–95	75–95	35–60	20–35
0–5	90–100	90–100	85–95	60–75	20–30	5–10
0–5	95–100	95–100	90–100	75–95	45–70	30–45
0–5	90–100	90–100	80–90	25–40	15–20	NP–5
0–5	90–100	85–95	80–90	35–55	25–35	5–15
0–5	90–100	90–100	80–90	25–35	15–20	NP–5
0–5	80–100	80–95	75–85	50–70	20–35	5–10
5–10	60–75	60–75	45–75	40–75	55–70	30–45
0	95–100	95–100	90–100	75–85	55–65	30–45
0	95–100	95–100	90–100	75–85	55–65	30–45
0	95–100	95–100	90–100	75–85	55–65	30–45
0	95–100	95–100	90–100	80–95	55–65	30–45
15–30	85–95	85–95	75–90	60–80	55–65	30–45
0	95–100	95–100	90–100	75–85	55–65	30–45
15–30	85–95	85–95	75–90	60–80	55–65	30–45
0	95–100	95–100	90–100	80–95	55–65	30–45
0–5	90–100	90–100	60–90	35–65	25–35	2–10
5	35–50	20–50	10–40	0–5		NP
0–5	50–75	50–75	30–70	15–55	15–25	NP–5
10–20	25–55	20–55	10–35	0–12		NP
0–5	95–100	80–100	60–80	35–55		NP
0–5	60–95	60–95	50–80	25–50		NP

TABLE 8.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Fleer:				
Fe	0–30	Loam	ML, SM	A–4
	30–60	Very gravelly loamy sand, very gravelly sand.	GP–GM, GM	A–1
Fluetsch:				
Fh[1]:				
Fluetsch part	0–10	Sandy loam	SM	A–2
	10–30	Sandy clay loam	SM–SC, SC, CL–ML, CL	A–4, A–6
	30–60	Sandy loam	SM	A–2
Tiagos part	0–12	Fine sandy loam	SM, ML	A–4
	12–60	Fine sandy loam	SM, ML	A–4
Forelle:				
Fo	0–4	Loam	CL–ML, ML	A–4
	4–20	Clay loam	CL	A–6
	20–60	Gravelly sandy clay loam	GC, SC	A–2
Gelkie:				
GeD	0–5	Sandy loam	SM	A–2, A–4
	5–37	Gravelly sandy clay loam, sandy clay loam.	GC, SC	A–2
	37–60	Gravelly sandy loam, sandy loam	SM, GM	A–1, A–2
Gelkie variant:				
GkE	0–10	Sandy loam	SM	A–2, A–4
	10–25	Gravelly sandy clay loam	SM, GM	A–2, A–4
	25	Unweathered bedrock.		
Girardot:				
Gn	0–8	Silty clay loam	CL	A–6
	8–60	Sandy clay loam	SC	A–6
Gothic:				
GoE	0–4	Loam	CL–ML, CL, SC	A–4
	4–12	Clay loam	CL, SC	A–6
	12–30	Clay, clay loam	CL, CH, GC	A–7
	30–50	Clay loam	CL, GC	A–6, A–7
Grafen:				
Gr[1]:				
Grafen part	0–10	Extremely stony sandy loam	SM	A–2
	10–30	Extremely stony sandy loam	SM	A–2
	30	Weathered bedrock, unweathered bedrock.		
Rock outcrop part not estimated.				
Grimstone:				
Gs[1]:				
Grimstone part	0–12	Sandy loam	SM, ML	A–2, A–4, A–5
	12–20	Loam	ML, SM, MH	A–4, A–5
	20–27	Clay loam, loam	ML, MH	A–5, A–7
	27	Weathered bedrock.		
Siebert part	0–15	Gravelly loamy sand	SP–SM, GP–GM	A–1
	15–33	Very gravelly loamy sand, gravelly loamy sand.	SP–SC, GP–GC, GP–GM	A–1, A–2
	33	Weathered bedrock, unweathered bedrock.		
Handran:				
HaF	0–10	Extremely stony sandy loam	SM	A–1
	10–60	Extremely stony coarse sandy loam	SM	A–1, A–2

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–5	90–100	75–100	70–95	40–65	20–30	5–10
15–35	35–55	35–55	20–35	5–15	----------	NP
0–5	90–100	90–100	80–90	25–40	15–20	NP–5
0–5	90–100	85–95	80–90	35–55	25–35	5–15
0–5	90–100	90–100	80–90	25–35	15–20	NP–5
0	90–100	90–100	70–85	40–65	20–35	NP–5
0	90–100	90–100	70–85	40–55	20–35	NP–5
0–10	85–100	85–100	70–90	55–70	20–35	5–10
0–10	85–100	85–100	75–95	55–80	30–40	10–20
5–20	55–75	55–70	30–60	20–35	25–35	10–15
0–15	75–95	75–90	50–65	25–40	----------	NP
0–20	50–85	50–80	30–60	15–35	25–40	10–15
0–20	50–85	50–80	30–60	15–35	----------	NP
0	75–90	75–85	50–65	25–40	25–35	NP–5
0–10	50–80	50–75	40–65	20–40	30–40	5–10
0	90–100	85–95	80–95	60–90	35–40	15–20
0	90–100	85–95	75–85	35–50	25–35	10–15
0	90–100	85–100	70–85	40–55	20–35	5–10
0	90–100	80–100	80–90	60–70	30–35	10–15
0	90–100	90–100	85–95	80–90	40–60	25–35
0	90–100	90–100	85–95	70–80	35–50	25–35
30–60	85–90	65–75	55–60	30–40	15–20	NP–5
60–80	75–80	50–60	35–45	25–30	15–20	NP–5
0–10	75–100	75–100	70–90	30–55	25–45	NP–4
0–10	75–100	75–100	70–90	40–70	35–55	NP–10
0–20	75–100	75–100	70–95	50–80	40–60	5–15
10–20	35–55	35–50	25–35	5–10	----------	NP
10–20	35–55	35–50	30–40	5–10	----------	5–10
65–80	60–70	40–50	30–40	10–25	15–25	NP–5
50–65	65–75	50–65	35–45	15–30	15–25	NP–5

TABLE 8.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Kather:				
KaE	0–7	Clay loam	CL, CH	A–6, A–7
	7–32	Clay	CH	A–7
	32	Weathered bedrock.		
Larand:				
LaE, LaF	0–16	Fine sandy loam	SM	A–4
	16–32	Very gravelly sandy clay loam	GM–GC, GC	A–2, A–4
	32–60	Very gravelly sand	GP	A–1
Leavitt:				
Le	0–13	Loam	ML, SM	A–4
	13–37	Clay loam	CL	A–6
	37–60	Loam	ML	A–4
Lulude:				
LuE	0–22	Cobbly loam	GM, SM, ML	A–2, A–4
	22–30	Very cobbly clay loam	GM, SM, ML	A–4
	30	Unweathered bedrock.		
Lymanson:				
LyD	0–9	Cobbly loam	CL–ML, ML	A–4
	9–30	Cobbly clay loam, cobbly loam	CL	A–6
	30	Weathered bedrock.		
MacFarlane:				
Ma[1]:				
MacFarlane part	0–18	Very stony sandy loam	GM, SM	A–2, A–4
	18–40	Extremely stony sandy loam	GM–GC, SM–SC	A–2
	40–60	Extremely stony sandy loam	GM, SM	A–1, A–2
Rock outcrop part not estimated.				
Manburn:				
MbF	0–7	Gravelly coarse sandy loam	SM	A–1, A–2
	7–14	Gravelly sandy clay loam, gravelly clay loam, gravelly loam.	SC, GC	A–6
	14	Weathered bedrock.		
Mendenhall:				
Me	0–10	Loam	CL, ML–CL	A–4, A–6
	10–60	Sandy loam, gravelly sandy loam	SM	A–2
Mine pits and dumps:				
Mn.				
Not estimated.				
Mirror:				
Mo[1]:				
Mirror part	0–7	Gravelly sandy loam	SM, GM	A–2, A–1
	7–32	Extremely stony sandy loam	SM, GM	A–1, A–2
	32	Unweathered bedrock.		
Rock outcrop part not estimated.				
Mord:				
MrD	0–16	Loam	CL, CL–ML	A–4
	16–21	Gravelly clay loam	CL	A–6, A–7
	21–34	Gravelly clay	CL, CH, GC	A–7
	34–60	Gravelly clay loam	CL, GC	A–6, A–7
Morset:				
MsD	0–7	Loam	ML, CL–ML	A–4, A–6
	7–18	Clay loam	CL	A–6
	18–60	Loam	ML, CL–ML	A–4

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	80–100	75–100	70–95	55–75	30–60	15–30
0	80–100	75–100	70–100	60–90	40–70	20–35
5–10	90–95	85–90	55–65	35–45	20–35	NP–5
35–45	45–65	45–65	30–45	20–40	20–25	5–10
35–50	35–50	35–50	15–30	0–5		NP
0	75–100	75–100	70–90	40–60	25–35	NP–5
0	75–100	75–100	70–100	55–80	30–40	10–15
0	75–100	75–100	65–90	50–70	25–35	NP–10
25–50	50–75	50–75	45–70	30–55	20–35	NP–10
50–80	50–75	50–75	45–75	35–60	30–40	5–10
30–45	90–100	90–100	75–95	55–70	20–35	5–10
30–45	90–100	90–100	85–90	75–80	35–40	15–25
40–80	60–80	50–75	45–70	30–50	20–35	NP–5
50–80	50–80	50–75	30–50	15–30	20–30	5–10
60–90	50–80	50–75	30–50	15–30	20–30	NP–5
0–10	75–80	50–75	35–40	20–30	15–20	NP–5
0–10	55–75	50–75	40–50	25–45	20–35	10–15
0–5	80–100	75–95	65–80	55–65	20–35	5–15
0–10	70–100	60–90	50–60	25–35	15–20	NP–5
15–30	55–75	35–75	25–30	15–30	25–35	NP–5
40–80	40–75	35–75	25–50	15–30	20–30	NP–5
15–50	85–95	85–95	75–85	55–70	20–30	5–10
0	60–80	60–75	55–70	50–60	30–50	15–25
0–5	55–75	50–75	50–70	45–65	40–60	15–30
0–10	55–75	50–75	45–70	45–55	30–50	15–25
0	85–95	85–95	80–85	55–70	20–35	5–15
0	90–100	90–100	80–90	60–70	30–40	10–20
0–5	75–100	75–100	70–80	50–65	15–35	NP–10

TABLE 8.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Muggins:				
MuE	0–8	Loam	ML	A–4
	8–13	Clay loam	CL, SC	A–6
	13–40	Clay, clay loam	CH, CL	A–7
	40–60	Clay loam	CL, SC	A–6
Nokhu:				
NoE, NoF	0–14	Loam	ML	A–4
	14–32	Clay loam	CL, CH	A–7
	32–60	Clay loam	CL	A–6, A–7
Norriston:				
Nr	0–9	Gravelly sandy loam	SC, GC	A–2
	9–16	Gravelly coarse sandy loam	SC, GC	A–2
	16–60	Very gravelly loamy coarse sand	GP–GM	A–1
Owen Creek:				
Oc	0–12	Sandy loam	SM	A–2, A–4
	12–36	Clay loam	CL	A–7
	36	Unweathered bedrock.		
On[1]:				
Owen Creek part	0–12	Sandy loam	SM	A–2, A–4
	12–36	Clay loam	CL	A–7
	36	Unweathered bedrock.		
Norriston part	0–9	Gravelly coarse sandy loam	SC, GC	A–2
	9–16	Gravelly coarse sandy loam	SC, GC	A–2
	16–60	Very gravelly loamy coarse sand	GP–GM	A–1
Parkview:				
PaF	0–9	Very stony loam	SM	A–2
	9–34	Extremely stony sandy clay loam	SC	A–2
	34	Weathered bedrock, unweathered bedrock.		
Peeler:				
PeE, PeF	0–11	Sandy loam	SM	A–2, A–4
	11–20	Gravelly sandy clay loam, sandy clay loam.	SC	A–2, A–6
	20–60	Gravelly coarse sandy loam, coarse sandy loam.	SM	A–1
Perceton:				
Ph[1]:				
Perceton part	0–20	Sandy loam	SM	A–2
	20–34	Sandy clay loam	SC, SM–SC	A–2
	34	Weathered bedrock, unweathered bedrock.		
Hyannis part	0–3	Fine sandy loam	SM	A–2, A–4
	3–12	Gravelly loamy sand	SM, GM	A–1
	12–30	Very cobbly loamy sand	SM, GM	A–1
	30	Weathered bedrock.		
Pinkham:				
Pr[1]:				
Pinkham part	0–4	Stony sandy loam	SM	A–4
	4–14	Very stony sandy loam	SM	A–1, A–2
	14–60	Extremely stony sandy loam	SM	A–2
Rock outcrop part not estimated.				
Randman:				
Ra	0–10	Gravelly sandy loam, sandy loam	SM	A–2, A–4
	10–30	Gravelly sandy clay loam, sandy clay loam.	SC–SM, SC	A–2, A–4
	30–60	Very gravelly sand	GP, SP	A–1

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–10	90–100	85–95	80–90	50–65	20–30	NP–5
10–25	95–100	85–95	65–70	45–55	30–35	10–15
15–40	95–100	90–100	70–80	50–75	40–55	20–30
15–40	95–100	85–95	65–75	45–55	30–40	10–15
0	95–100	95–100	85–95	60–75	25–35	NP–10
0	95–100	95–100	95–100	65–80	40–70	15–40
0	95–100	95–100	95–100	65–75	25–50	10–25
0	55–75	50–70	25–45	15–20	25–35	10–15
0	55–75	50–70	25–30	15–20	25–35	10–15
0	30–50	30–50	20–30	5–12	----------	NP
0	85–100	75–100	50–75	25–50	----------	NP
0	85–100	75–100	70–95	60–80	40–50	20–30
0	85–100	75–100	50–75	25–50	----------	NP
0	85–100	75–100	70–95	60–80	40–50	20–30
0	55–75	50–70	25–45	15–20	25–35	10–15
0	55–75	50–70	25–30	15–20	25–35	10–15
0	30–50	30–50	20–30	5–12	----------	NP
70–80	65–70	40–45	35–40	25–30	20–35	NP–5
75–85	70–75	55–65	40–45	25–35	25–40	10–15
0	90–95	80–90	50–65	25–40	20–25	NP–5
0–5	65–90	50–80	30–45	20–40	30–35	10–15
0–5	65–80	50–80	20–30	15–25	15–20	NP–5
0–5	90–100	80–95	30–40	15–20	15–20	NP–5
0–5	90–100	80–95	40–55	30–35	25–35	5–15
0–10	80–100	75–95	50–80	30–50	----------	NP
5–15	50–75	50–75	25–50	10–20	----------	NP
40–80	50–75	50–75	25–50	10–20	----------	NP
15–35	75–90	75–90	55–75	35–45	15–25	NP
35–80	65–80	60–80	35–55	20–30	15–25	NP–5
60–80	75–80	50–65	35–45	20–30	15–25	NP–5
0	90–100	75–90	60–70	25–40	15–20	NP–5
0–5	50–75	50–75	40–60	25–40	20–30	5–10
10–20	45–55	45–55	15–30	0–5	----------	NP

TABLE 8.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Rawah:				
RhD	0–7	Loam	ML, CL	A–4
	7–30	Clay loam, loam	CL, ML	A–4, A–6
	30	Weathered bedrock, unweathered bedrock.		
Rock land:				
Rk.				
Not estimated.				
Rock outcrop:				
Ro.				
Not estimated.				
Rogert:				
RtE	0–14	Gravelly sandy loam	GP–GM, GM	A–1
	14–20	Unweathered bedrock.		
Spicerton:				
Sp	0–2	Sandy loam	SM	A–2
	2–60	Clay, clay loam	CH	A–7
Stumpp:				
St	0–3	Clay loam	CL, CL–ML	A–6, A–4
	3–32		CH	A–7
	32–60	Very gravelly loamy sand, gravelly sand	SP–SM, GP–GM	A–1
Sudduth:				
SuE	0–4	Loam	ML	A–4
	4–20	Clay loam	CL	A–7
	20–60	Clay	CH	A–7
Tealson:				
Te[1]:				
Tealson part	0–10	Sandy loam	SM	A–2
	10–16	Channery sandy loam	SM, GM	A–1, A–2
	16	Weathered bedrock, unweathered bedrock.		
Rock land part not estimated.				
Tine:				
Tn	0–18	Sandy loam	SM	A–2
	18–60	Gravelly sandy loam, gravelly loamy sand, very gravelly loamy sand.	GP–GM, SP–SM, GM, SM	A–1
Troutville:				
ToF	0–8	Sandy loam	SM	A–2, A–4
	8–60	Very gravelly sandy loam	GM, SM	A–1, A–2
Tv[1]:				
Troutville part	0–8	Sandy loam	SM	A–2, A–4
	8–60	Very gravelly sandy loam	GM, SM	A–1, A–2
Newcomb part	0–15	Loam	ML	A–4, A–6
	15–60	Very gravelly loamy sand	GP–GM	A–1
Walden:				
Wa	0–10	Sandy loam	SM	A–2, A–4
	10–35	Sandy clay loam, gravelly sandy clay loam.	SC	A–6
	35–60	Very gravelly loamy sand, very gravelly sand.	GP–GM, GM	A–1
Wichup:				
Wc	0–14	Loam	CL–ML, CL	A–4
	14–60	Sandy loam, gravelly sandy loam	SM, GM	A–2, A–4
Yochum:				
YoF	0–8	Gravelly sandy loam	SM, GM	A–1
	8–26	Very gravelly sandy loam	GM	A–1
	26	Weathered bedrock.		

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior

[2] NP=nonplastic.

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–5	90–100	90–100	75–90	60–75	25–35	NP–5
0–5	90–100	90–100	80–95	60–75	25–35	5–15
10–25	15–50	15–50	10–35	5–20	----------	NP
0	90–100	90–100	60–75	15–30	----------	NP
0	85–100	85–100	80–100	75–95	55–70	30–45
0–5	95–100	95–100	85–95	60–75	20–40	5–15
0–5	95–100	90–100	90–95	75–95	50–70	30–45
0–5	40–70	35–60	35–40	5–10	----------	NP
0	95–100	85–90	75–85	55–70	30–40	5–10
0	95–100	90–95	85–95	65–75	40–50	20–30
0	95–100	90–95	85–95	70–90	55–65	30–40
0–10	90–100	75–90	45–65	25–35	15–25	NP–5
0–10	50–75	50–75	30–50	15–30	----------	NP
0–10	80–100	75–95	55–60	25–35	15–20	NP–5
0–10	35–75	35–75	20–35	5–20	----------	NP
0–5	75–95	75–90	50–65	30–40	15–20	NP–5
40–80	50–75	45–70	30–40	20–35	15–20	NP–5
0–5	75–95	75–90	50–65	30–40	15–20	NP–5
40–80	50–75	45–70	30–40	20–35	15–20	NP–5
0–5	90–100	85–95	75–85	55–70	30–40	5–15
0–5	25–50	20–40	20–30	5–12	----------	NP
0–5	90–95	80–90	50–65	25–40	20–25	NP–5
0–10	65–95	60–90	50–80	35–50	25–35	10–15
0–10	40–50	40–50	15–30	5–15	----------	NP
0	90–100	90–100	85–95	60–70	20–30	5–15
0–5	60–90	50–85	50–70	30–40	15–20	NP–5
5–15	40–65	35–65	30–40	12–25	15–20	NP–5
5–15	35–60	35–55	30–35	12–25	15–20	NP–5

of the whole mapping unit.

TABLE 9.—*Physical and chemical*

[The symbol < means less than; > means greater than. The erosion tolerance factor

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Aaberg:				
Ab[1]:				
Aaberg part	0–4	0.06–0.2	0.14–0.16	6.6–7.8
	4–30	0.06–0.2	0.12–0.15	6.6–8.4
	30			
Barishman part	0–12	0.60–2.0	0.13–0.17	6.1–7.3
	12–60	0.06–0.20	0.14–0.16	6.6–8.4
Agneston:				
Ag	0–6	2.0–6.0	0.10–0.14	4.5–6.0
	6–25	0.6–2.0	0.08–0.12	4.5–5.5
	25			
Badland:				
Ba.				
Not estimated.				
Bangston:				
Bg	0–26	6.0–20	0.06–0.09	6.6–7.3
	26–60	6.0–20	0.05–0.08	6.6–7.8
Blackwell:				
Bk	0–13	0.2–2.0	0.19–0.21	5.6–6.5
	13–46	0.2–0.6	0.15–0.17	6.1–6.5
	46–60	0.6–6.0	0.11–0.14	6.1–7.3
Blevinton:				
Bn	0–8	2.0–6.0	0.14–0.16	6.6–7.3
	8–60	2.0–6.0	0.12–0.14	6.6–7.8
Boettcher:				
Bo[1]:				
Boettcher part	0–4	0.2–0.6	0.14–0.16	7.4–7.8
	4–29	0.06–0.2	0.14–0.16	7.4–8.4
	29			
Bundyman part	0–4	0.06–0.2	0.17–0.20	6.6–7.8
	4–25	0.06–0.2	0.17–0.20	6.6–7.8
	25			
Bosler:				
Bs	0–3	2.0–6.0	0.13–0.15	6.6–7.8
	3–21	0.6–2.0	0.16–0.18	7.9–9.0
	21–60	6.0–20	0.03–0.05	7.9–9.0
Bowen:				
Bw	0–10	2.0–6.0	0.07–0.10	6.6–7.3
	10–28	2.0–6.0	0.06–0.09	6.6–7.3
	28			
Brinkert:				
Bx[1]:				
Brinkert part	0–5	0.6–2.0	0.16–0.21	6.6–7.3
	5–25	0.2–0.6	0.14–0.21	7.4–7.8
	25–60	0.6–2.0	0.14–0.16	7.4–7.8
Morset part	0–7	0.6–2.0	0.15–0.19	7.4–7.8
	7–18	0.6–2.0	0.16–0.20	7.4–8.4
	18–60	0.6–2.0	0.15–0.17	7.4–8.4
Buffmeyer:				
By	0–13	6.0–20	0.11–0.13	6.6–7.3
	13–60	2.0–6.0	0.07–0.09	6.6–7.3

properties of soils

(T) is for the entire profile. Absence of an entry means data were not estimated]

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
mmhos/cm					
<2	High	High	Low	0.15	3
<2	High	High	Low	.24	
<2	Low	High	Low	.32	5
<2	High	High	Low	.28	
<2	Low	Moderate	Moderate	.17	2
<2	Low	Moderate	High	.10	
<2	Low	Low	Low	.10	5
<2	Low	Low	Low	.10	
<2	Moderate	High	Moderate	.15	5
<2	Moderate	High	Moderate	.15	
<2	Low	High	Low	.15	
<2	Low	Moderate	Low	.20	5
<2	Low	Moderate	Low	.24	
<2	High	High	Low	.32	2
<2	High	High	Low	.32	
<2	High	Low	Low	.37	2
<2	High	Low	Low	.43	
<2	Low	High	Low	.20	3
<2	Moderate	High	Low	.28	
<2	Very low	High	Low	.10	
<2	Low	Low	Low	.15	2
<2	Low	Low	Low	.15	
<2	Low	High	Low	.28	5
<2	High	High	Low	.28	
<2	Moderate	High	Low	.24	
<2	Low	Moderate	Low	.24	5
<2	Moderate	High	Low	.28	
<2	Low	High	Low	.24	
<2	Low	Low	Low	.15	5
<2	Low	Low	Low	.10	

TABLE 9.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Cabin:				
Ca	0–4	6.0–20	0.06–0.09	6.1–7.8
	4–26	0.6–2.0	0.10–0.14	6.1–7.8
	26–60	6.0–20	0.04–0.06	6.1–7.8
Chedsey:				
Cd	0–13	0.6–2.0	0.16–0.20	6.6–7.8
	13–36	0.06–0.2	0.14–0.16	7.4–8.4
	36			
Coalmont:				
Cf[1]:				
Coalmont part	0–4	0.6–2.0	0.16–0.18	6.6–8.4
	4–30	0.06–0.2	0.14–0.16	7.4–8.4
	30			
Fluetsch part	0–10	6.0–20	0.11–0.13	6.6–7.8
	10–30	0.6–2.0	0.14–0.16	7.4–8.4
	30–60	2.0–6.0	0.11–0.13	7.9–8.4
Cowdrey:				
CoD, CoF	0–12	0.6–2.0	0.15–0.17	6.1–6.5
	12–60	0.06–0.2	0.14–0.16	6.1–7.3
Crespin:				
Cr[1]:				
Crespin part	0–9	0.06–0.2	0.14–0.16	6.6–7.8
	9–60	0.06–0.2	0.12–0.15	6.6–7.8
Carlstrom part	0–7	0.06–0.2	0.14–0.16	6.1–7.8
	7–26	0.06–0.2	0.12–0.15	6.1–7.8
	26			
Cs[1]:				
Crespin part	0–9	0.06–0.2	0.13–0.15	6.6–7.8
	9–60	0.06–0.2	0.12–0.15	6.6–7.8
Carlstrom part	0–7	0.06–0.2	0.13–0.15	6.1–7.8
	7–26	0.06–0.2	0.12–0.15	6.1–7.8
	26			
Cryaquents:				
Ct.				
Not estimated.				
Cryorthents:				
CyF.				
Not estimated.				
Dobrow:				
Do	0–28	2.0–6.0	0.13–0.18	6.6–7.3
	28–60	6.0–20	0.03–0.05	6.6–7.3
Dune land:				
Du.				
Not estimated.				
Eachuston:				
Ea	0–8	2.0–6.0	0.07–0.10	6.6–7.3
	8–60	6.0–20	0.04–0.06	6.6–7.3
Ethelman:				
EhE	0–7	2.0–6.0	0.13–0.15	6.6–7.8
	7–29	2.0–6.0	0.13–0.15	6.6–8.4
	29			
Fleer:				
Fe	0–30	0.60–2.0	0.13–0.18	7.9–8.4
	30–60	2.0–6.0	0.03–0.08	7.4–7.8

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
mmhos/cm					
<2	Low	Low	Low	.17	4
<2	Low	Low	Low	.10	
<2	Low	Low	Low	.10	
<2	Low	Moderate	Low	.20	2
<2	High	High	Low	.24	
<2	Low	High	Low	.24	2
<2	High	High	Low	.32	
<2	Low	High	Low	.32	5
<2	Moderate	High	Low	.37	
<2	Low	High	Low	.20	
<2	Low	High	Low	.32	5
<2	High	High	Low	.10	
<2	High	High	Low	.24	5
<2	High	High	Low	.32	
<2	High	High	Low	.24	2
<2	High	High	Low	.32	
<2	High	High	Low	.17	5
<2	High	High	Low	.32	
<2	High	High	Low	.17	2
<2	High	High	Low	.32	
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	Moderate	Low	.28	2
<2	Low	High	Low	.24	
<2	Low	High	Low		
<2	Low	High	Low		

TABLE 9.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Fluetsch:				
Fh [1]:				
Fluetsch part	0–10	6.0–20	0.11–0.13	6.6–7.8
	10–30	0.6–2.0	0.14–0.16	7.4–8.4
	30–60	2.0–6.0	0.11–0.13	7.9–8.4
Tiagos part	0–12	2.0–6.0	0.13–0.15	6.6–7.3
	12–60	2.0–6.0	0.12–0.14	6.6–7.8
Forelle:				
Fo	0–4	0.6–2.0	0.16–0.18	6.6–7.8
	4–20	0.6–2.0	0.16–0.21	6.6–8.4
	20–60	0.6–2.0	0.10–0.14	7.9–9.0
Gelkie:				
GeD	0–5	2.0–6.0	0.10–0.13	6.6–7.3
	5–37	0.6–2.0	0.10–0.13	6.6–9.0
	37–60	2.0–6.0	0.07–0.10	7.9–9.0
Gelkie variant:				
GkE	0–10	2.0–6.0	0.13–0.15	6.1–7.3
	10–25	0.6–2.0	0.14–0.16	6.1–7.3
	25			
Girardot:				
Gn	0–8	0.2–0.6	0.19–0.21	7.9–8.4
	8–60	0.6–2.0	0.14–0.16	7.9–8.4
Gothic:				
GoE	0–4	0.6–2.0	0.14–0.18	6.6–7.3
	4–12	0.6–2.0	0.14–0.16	6.6–7.3
	12–30	0.06–0.20	0.14–0.16	6.6–7.3
	30–50	0.06–0.20	0.14–0.16	7.4–7.8
Grafen:				
Gr [1]:				
Grafen part	0–10	6.0–20	0.07–0.09	6.6–7.3
	10–30	6.0–20	0.07–0.09	6.6–7.8
	30			
Rock outcrop part not estimated.				
Grimstone:				
Gs [1]:				
Grimstone part	0–12	2.0–6.0	0.13–0.16	5.6–6.5
	12–20	2.0–6.0	0.14–0.18	6.1–7.3
	20–27	0.6–2.0	0.16–0.20	6.1–7.3
	27			
Siebert part	0–15	6.0–20	0.05–0.07	5.6–7.3
	15–33	6.0–20	0.08–0.10	6.1–7.3
	33			
Handran:				
HaF	0–10	6.0–20	0.05–0.07	5.6–7.8
	10–60	6.0–20	0.07–0.09	6.6–7.8
Kather:				
KaE	0–7	0.2–0.6	0.18–0.20	6.6–7.8
	7–32	0.06–0.2	0.14–0.17	7.3–7.8
	32			
Larand:				
LaE, LaF	0–16	6.0–20	0.12–0.14	5.6–6.5
	16–32	0.6–2.0	0.07–0.09	6.1–6.5
	32–60	>20	0.03–0.05	6.1–7.8

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
mmhos/cm					
<2	Low	High	Low	.32	5
<2	Moderate	High	Low	.37	
<2	Low	High	Low	.20	
<2	Low	High	Low	.15	5
<2	Low	High	Low	.15	
<2	Low	High	Low	.28	5
<2	Moderate	High	Low	.32	
<2	Moderate	High	Low	.28	
<2	Low	Moderate	Low	.24	5
<2	Moderate	High	Low	.24	
<2	Low	High	Low	.24	
<2	Low	Moderate	Low	.20	2
<2	Low	Moderate	Low	.20	
<4	Moderate	High	Low	.17	5
<4	Moderate	High	Low	.17	
<2	Low	Low	Low	.17	5
<2	Moderate	Low	Low	.15	
<2	High	Low	Low	.10	
<2	High	Moderate	Low	.10	
<2	Low	Low	Low	.17	3
<2	Low	Low	Low	.15	
<2	Low	Moderate	Moderate	.17	2
<2	Low	Moderate	Moderate	.24	
<2	Low	Moderate	Moderate	.28	
<2	Low	High	Low	.10	2
<2	Low	High	Low	.10	
<2	Low	Moderate	Low	.10	3
<2	Low	Moderate	Low	.15	
<2	Moderate	Moderate	Low	.15	2
<2	High	High	Low	.20	
<2	Low	Moderate	Low	.24	3
<2	Low	Moderate	Low	.24	
<2	Low	Moderate	Low	.28	

TABLE 9.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Leavitt:				
Le	0–13	0.6–2.0	0.19–0.21	6.1–7.8
	13–37	0.6–2.0	0.19–0.21	6.6–7.8
	37–60	0.6–2.0	0.16–0.18	7.9–9.0
Lulude:				
LuE	0–22	0.6–2.0	0.11–0.14	5.6–6.5
	22–30	0.6–2.0	0.07–0.10	5.6–7.3
	30			
Lymanson:				
LyD	0–9	0.6–2.0	0.12–0.14	6.6–7.3
	9–30	0.6–2.0	0.14–0.16	7.9–8.4
	30			
MacFarlane:				
Ma[1]:				
MacFarlane part	0–18	2.0–6.0	0.09–0.12	5.6–7.3
	18–40	2.0–6.0	0.06–0.08	6.6–7.8
	40–60	2.0–6.0	0.05–0.07	6.6–7.8
Rock outcrop part not estimated.				
Manburn:				
MbF	0–7	2.0–6.0	0.07–0.09	6.1–7.8
	7–14	0.6–2.0	0.09–0.12	5.6–7.8
	14			
Mendenhall:				
Me	0–10	0.6–2.0	0.16–0.18	7.4–8.4
	10–60	2.0–6.0	0.11–0.13	7.9–8.4
Mine pits and dumps:				
Mn.				
Not estimated.				
Mirror:				
Mo[1]:				
Mirror part	0–7	0.6–2.0	0.19–0.22	4.5–5.5
	7–32	2.0–6.0	0.05–0.07	4.5–5.5
	32			
Rock outcrop part not estimated.				
Mord:				
MrD	0–16	0.6–2.0	0.18–0.20	6.1–7.3
	16–21	0.2–0.6	0.19–0.21	6.1–7.3
	21–34	0.06–0.2	0.14–0.16	6.1–7.3
	34–60	0.2–0.6	0.16–0.18	6.1–7.3
Morset:				
MsD	0–7	0.6–2.0	0.15–0.19	7.4–7.8
	7–18	0.6–2.0	0.16–0.20	7.4–8.4
	18–60	0.6–2.0	0.15–0.17	7.4–8.4
Muggins:				
MuE	0–8	0.6–2.0	0.15–0.17	6.1–6.5
	8–13	0.2–0.6	0.14–0.16	6.1–6.5
	13–40	0.06–0.2	0.15–0.17	6.1–6.5
	40–60	0.2–0.6	0.14–0.16	5.6–6.5
Nokhu:				
NoE, NoF	0–14	0.6–2.0	0.16–0.18	6.1–7.3
	14–32	0.06–0.2	0.18–0.20	6.6–7.3
	32–60	0.06–0.6	0.18–0.20	7.9–9.0

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
mmhos/cm					
<2	Low	High	Low	.37	5
<2	Moderate	High	Low	.32	
<2	Low	High	Low	.28	
<2	Low	High	Low	.10	2
<2	Low	High	Low	.10	
<2	Low	Moderate	Low	.24	2
<2	Moderate	High	Low	.32	
<2	Low	Moderate	Low	.10	5
<2	Low	Moderate	Low	.10	
<2	Low	Moderate	Low	.10	
<2	Low	Moderate	Low	.10	1
<2	Low	Moderate	Low	.10	
2–4	Low	High	Low	.37	5
2–4	Low	High	Low	.28	
<2	Low	High	High	.15	3
<2	Low	High	High	.10	
<2	Moderate	High	Low	.24	5
<2	High	High	Low	.37	
<2	High	High	Low	.32	
<2	High	High	Low	.37	
<2	Low	Moderate	Low	.24	5
<2	Moderate	High	Low	.28	
<2	Low	High	Low	.24	
<2	Low	High	Low	.32	5
<2	Moderate	High	Low	.15	
<2	High	High	Low	.10	
<2	Moderate	High	Low	.10	
<2	Low	Low	Low	.28	5
<2	High	Low	Low	.28	
<2	Moderate	High	Low	.24	

TABLE 9.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Norriston:				
Nr	0–9	6.0–20	0.10–0.12	6.1–7.8
	9–16	6.0–20	0.08–0.10	6.6–7.8
	16–60	>20	0.05–0.07	6.6–7.8
Owen Creek:				
Oc	0–12	0.6–2.0	0.19–0.21	6.6–7.8
	12–36	0.06–0.2	0.15–0.18	6.6–8.4
	36			
On[1]:				
Owen Creek part	0–12	0.6–2.0	0.19–0.21	6.6–7.8
	12–36	0.06–0.2	0.15–0.18	6.6–8.4
	36			
Norriston part	0–9	6.0–20	0.10–0.12	6.1–7.8
	9–16	6.0–20	0.08–0.10	6.6–7.8
	16–60	>20	0.05–0.07	6.6–7.8
Parkview:				
PaF	0–9	2.0–6.0	0.06–0.08	6.1–7.8
	9–34	0.6–2.0	0.05–0.07	6.6–7.8
	34			
Peeler:				
PeE, PeF	0–11	2.0–6.0	0.12–0.14	6.1–7.3
	11–20	0.6–2.0	0.14–0.16	6.1–7.3
	20–60	6.0–20	0.07–0.09	6.1–7.8
Perceton:				
Ph[1]:				
Perceton part	0–20	6.0–20	0.11–0.13	5.6–7.3
	20–34	0.6–2.0	0.14–0.16	5.6–7.3
	34			
Hyannis part	0–3	2.0–6.0	0.12–0.16	5.6–6.5
	3–12	6.0–20	0.06–0.08	5.6–6.5
	12–30	6.0–20	0.04–0.06	5.6–7.3
	30			
Pinkham:				
Pr[1]:				
Pinkham part	0–4	6.0–20	0.10–0.14	4.5–6.0
	4–14	6.0–20	0.05–0.09	4.5–6.0
	14–60	6.0–20	0.05–0.07	4.5–6.0
Rock outcrop part not estimated.				
Randman:				
Ra	0–10	6.0–20	0.11–0.13	6.6–7.8
	10–30	0.6–2.0	0.14–0.16	7.4–7.8
	30–60	>20	0.04–0.06	7.4–7.8
Rawah:				
RhD	0–7	0.60–2.0	0.16–0.18	6.6–7.8
	7–30	0.60–2.0	0.16–0.18	7.4–8.4
	30			
Rock land:				
Rk.				
Not estimated.				
Rock outcrop:				
Ro.				
Not estimated.				
Rogert:				
RtE	0–14	6.0–20	0.05–0.07	6.1–7.8
	14–20			

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
mmhos/cm					
<2	Low	Moderate	Low	.10	3
<2	Low	Moderate	Low	.10	
<2	Low	Moderate	Low	.10	
<2	Low	Moderate	Low	.28	2
<2	High	High	Low	.32	
<2	Low	Moderate	Low	.28	2
<2	High	High	Low	.32	
<2	Low	Moderate	Low	.10	3
<2	Low	Moderate	Low	.10	
<2	Low	Moderate	Low	.10	
<2	Low	High	Low	.14	2
<2	Low	High	Low	.10	
<2	Low	High	Low	.28	5
<2	Low	Moderate	Low	.15	
<2	Low	Moderate	Low	.15	
<2	Low	High	Low	.15	3
<2	Low	High	Low	.15	
<2	Low	High	Low	.32	2
<2	Low	High	Low	.10	
<2	Low	High	Low	.10	
<2	Low	High	High	.10	5
<2	Low	High	High	.10	
<2	Low	High	High		
<2	Low	High	Low	.15	2
<2	Low	High	Low	.15	
<2	Low	High	Low	.10	
<2	Low	High	Low	.28	2
<2	Moderate	High	Low	.28	
<2	Low	Moderate	Low	.10	1

TABLE 9.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Spicerton:				
Sp	0–2	2.0–6.0	0.09–0.10	8.5–9.0
	2–60	0.06–0.2	0.10–0.14	>9.0
Stumpp:				
St	0–3	0.20–0.60	0.16–0.18	8.5–9.0
	3–32	0.06–0.20	0.12–0.14	>9.0
	32–60	>20	0.06–0.08	7.9–8.4
Sudduth:				
SuE	0–4	0.6–2.0	0.16–0.18	6.1–7.3
	4–20	0.2–0.6	0.19–0.21	6.1–7.3
	20–60	0.06–0.2	0.14–0.16	6.1–7.8
Tealson:				
Te[1]:				
Tealson part	0–10	6.0–20	0.09–0.13	6.6–8.4
	10–16	6.0–20	0.07–0.10	7.4–8.4
	16			
Rock land part not estimated.				
Tine:				
Tn	0–18	6.0–20	0.11–0.13	6.1–7.8
	18–60	6.0–20	0.05–0.08	6.6–7.8
Troutville:				
ToF	0–8	2.0–6.0	0.07–0.10	6.1–7.3
	8–60	2.0–6.0	0.07–0.10	6.1–7.3
Tv[1]:				
Troutville part	0–8	2.0–6.0	0.07–0.10	6.1–7.3
	8–60	2.0–6.0	0.07–0.10	6.1–7.3
Newcomb part	0–15	0.6–2.0	0.16–0.18	6.1–7.3
	15–60	6.0–20	0.06–0.08	6.1–7.3
Walden:				
Wa	0–10	2.0–6.0	0.13–0.15	6.6–8.4
	10–35	0.6–2.0	0.14–0.16	7.4–8.4
	35–60	>20	0.05–0.07	7.9–9.0
Wichup:				
Wc	0–14	2.0–6.0	0.16–0.18	6.1–7.8
	14–60	0.6–2.0	0.11–0.13	6.1–7.8
Yochum:				
YoF	0–8	2.0–6.0	0.07–0.09	5.6–7.3
	8–26	2.0–6.0	0.07–0.09	5.6–7.3
	26			

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior

flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; absence of distinctive soil horizons that form in soils of the area that are not subject to flooding; local information about flood water heights and the extent of flooding; and local knowledge that relates the unique landscape position of each soil to historic floods.

The generalized description of flood hazards is of value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

A *high water table* is the highest level of a saturated zone more than 6 inches thick in soils for a continuous period of more than 2 weeks during most years. The estimates apply to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the seasonal high water table; the kind of

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
mmhos/cm					
>8	Low	High	High	.32	5
>8	High	High	High	.32	
8–15	Low	High	Low	.32	3
8–15	High	High	Low	.32	
8–15	Low	High	Low	.10	
<2	Low	Low	Low	.28	5
<2	Moderate	Moderate	Low	.37	
<2	High	Moderate	Low	.43	
<2	Low	High	Low	.15	1
<2	Low	High	Low	.10	
<2	Low	High	Low	.15	3
<2	Low	High	Low	.10	
<2	Low	High	Low	.15	5
<2	Low	High	Low	.10	
<2	Low	High	Low	.15	5
<2	Low	High	Low	.10	
<2	Low	Moderate	Low	.24	5
<2	Low	Moderate	Low	.10	
<2	Low	High	Low	.28	3
<2	Low	High	Low	.17	
<2	Low	High	Low	.10	
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	High	Moderate	.10	2
<2	Low	High	Moderate	.10	

of the whole mapping unit.

water table, whether perched, artesian, or apparent, the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to *bedrock* is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, limited range in depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and other observations during the soil mapping. Hardness of bedrock as related to ease of excavation is also shown. Rippable bedrock, by definition, can

TABLE 10.—*Soil and*

[Absence of an entry indicates the feature is not a concern. The Glossary gives descriptions

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Aaberg:				
Ab[1]:				
Aaberg part	D	None		
Barishman part	C	None		
Agneston:				
Ag	B	None		
Badland:				
Ba.				
Not estimated.				
Bangston:				
Bg	A	None		
Blackwell:				
Bk	D	Common	Brief	May-Jun
Blevinton:				
Bn	B	None		
Boettcher:				
Bo[1]:				
Boettcher part	C	None		
Bundyman part	C	None		
Bosler:				
Bs	B	None		
Bowen:				
Bw	B	None		
Brinkert:				
Bx[1]:				
Brinkert part	C	None		
Morset part	B	None		
Buffmeyer:				
By	B	None		
Cabin:				
Ca	B	None		
Chedsey:				
Cd	C	None		
Coalmont:				
Cf[1]:				
Coalmont part	C	None		
Fluetsch part	B	None		
Cowdrey:				
CoD, CoF	C	None		
Crespin:				
Cr, Cs[1]:				
Crespin parts	C	None		
Carlstrom parts	C	None		
Cryaquents:				
Ct	D	Frequent	Brief	May-Jun

water features

of symbols and such terms as "brief" and "long." The symbol > means greater than]

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
>6.0			20–40	Rippable	Low.
>6.0			>60		Low.
>6.0			20–40	Hard	Moderate.
>6.0			>60		Low.
1.5	Apparent	Apr-Jul	>60		High.
>6.0			>60		High.
>6.0			20–40	Rippable	Low.
>6.0			20–40	Rippable	Low.
>6.0			>60		Moderate.
>6.0			20–40	Hard	Moderate.
>6.0			>60		Low.
>6.0			>60		High.
>6.0			>60		Moderate.
>6.0			>60		Low.
>6.0			20–40	Rippable	Moderate.
>6.0			20–40	Rippable	Low.
>6.0			>60		Moderate.
>6.0			>60		Moderate.
>6.0			>60		Low.
>6.0			20–40	Rippable	Low.
0.5–1.5	Apparent	Apr-Aug	>60		High.

TABLE 10.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Cryorthents: CyF	D	None		
Dobrow: Do	B/D	Common	Long	May-Jun
Dune land: Du. Not estimated.				
Eachuston: Ea	A/D	Common	Long	Apr-Jun
Ethelman: EhE	B	None		
Fleer: Fe	A/D	Common	Long	Apr-Jun
Fluetsch: Fh[1]:				
Fluetsch part	B	None		
Tiagos part	B	None		
Forelle: Fo	B	None		
Gelkie: GeD	B	None		
Gelkie variant: GkE	B	None		
Girardot: Gn	D	Common	Long	May-Jun
Gothic: GoE	C	None		
Grafen: Gr[1]:				
Grafen part	B	None		
Rock outcrop part not estimated.				
Grimstone: Gs[1]:				
Grimstone part	B	None		
Siebert part	A	None		
Handran: HaF	A	None		
Kather: KaE	C	None		
Larand: LaE, LaF	B	None		
Leavitt: Le	B	None		
Lulude: LuE	B	None		

water features—Continued

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
>6.0			2–10	Rippable	Low.
0.5	Apparent	May-Jul	>60		High.
0–0.5	Apparent	May-Aug	>60		High.
>6.0			20–40	Rippable	High.
0–0.5	Apparent	Mar-Aug	>60		High.
>6.0			>60		Moderate.
>6.0			>60		Moderate.
>6.0			>60		Moderate.
>6.0			>60		Moderate.
>6.0			20–40	Hard	High.
0–0.5	Apparent	Mar-Aug	>60		High.
>6.0			>60		Moderate.
>6.0			20–40	Rippable	Low.
>6.0			20–40	Rippable	High.
>6.0			20–40	Rippable	Low.
>6.0			>60		Low.
>6.0			20–40	Rippable	Low.
>6.0			>60		Low.
>6.0			>60		Moderate.
>6.0			20–40	Hard	Moderate.

TABLE 10.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Lymanson: LyD	C	None		
MacFarlane: Ma[1]: **MacFarlane part**	B	None		
Rock outcrop part not estimated.				
Manburn: MbF	D	None		
Mendenhall: Me	D	Common	Long	Apr-Jun
Mine pits and dumps: Mn Not estimated.				
Mirror: Mo[1]: **Mirror part**	B	None		
Rock outcrop part not estimated.				
Mord: MrD	C	None		
Morset: MsD	B	None		
Muggins: MuE	C	None		
Nokhu: NoE, NoF	C	None		
Norriston: Nr	A	None		
Owen Creek: Oc	C	None		
On[1]: **Owen Creek part**	C	None		
Norriston part	A	None		
Parkview: PaF	B	None		
Peeler: PeE, PeF	B	None		
Perceton: Ph[1]: **Perceton part**	B	None		
Hyannis part	B	None		
Pinkham: Pr[1]: **Pinkham part**	B	None		
Rock outcrop part not estimated.				

water features—Continued

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
>6.0			20–40	Rippable	High.
>6.0			>60		Low.
>6.0			10–20	Rippable	Low.
0–0.5	Apparent	Mar-Aug	>60		High.
>6.0			20–40	Hard	Moderate.
>6.0			>60		Moderate.
>6.0			>60		High.
>6.0			>60		Moderate.
>6.0			>60		Moderate.
>6.0			>60		Low.
>6.0			20–40	Rippable	Moderate.
>6.0			20–40	Rippable	Moderate.
>6.0			>60		Low.
>6.0			20–40	Rippable	Low.
>6.0			>60		Moderate.
>6.0			20–40	Rippable	Moderate.
>6.0			20–40	Rippable	Low.
>6.0			>60		Low.

TABLE 10.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Randman:				
Ra	D	Rare		
Rawah:				
RhD	C	None		
Rock land:				
Rk.				
Not estimated.				
Rock outcrop:				
Ro.				
Not estimated.				
Rogert:				
RtE	D	None		
Spicerton:				
Sp	D	Frequent	Brief	Apr-May
Stumpp:				
St	D	Common	Long	Apr-Jun
Sudduth:				
SuE	C	None		
Tealson:				
Te[1]:				
Tealson part	D	None		
Rock land part not estimated.				
Tine:				
Tn	A	None		
Troutville:				
ToF	B	None		
Tv[1]:				
Troutville part	B	None		
Newcomb part	A	None		
Walden:				
Wa	D	Common	Long	May-Jun
Wichup:				
Wc	D	Common	Long	May-Jun
Yochum:				
YoF	C	None		

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior

be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and by low soil strength after thawing. Frost action is defined as freezing temperatures in the soil and movement of soil moisture into the freezing zone, which causes the formation of ice lenses. Texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Engineering interpretations of the soils

The interpretations in tables 11 through 14 are

water features—Continued

High water table			Bedrock		Potential frost action
Depth	Kind	Months	Depth	Hardness	
Ft			*In*		
0–0.5	Apparent	May-Jul	>60		High.
>6.0			20–40	Rippable	Low.
>6.0			10–20	Hard	Low.
>6.0			>60		Low.
2.0–3.0	Apparent	Apr-Jun	>60		Moderate.
>6.0			>60		Moderate.
>6.0			10–20	Rippable	Low.
>6.0			>60		Low.
>6.0			>60		Low.
>6.0			>60		Low.
>6.0			>60		Low.
1.0–2.0	Apparent	Mar-Jul	>60		High.
0–0.5	Apparent	Nov-Jul	>60		High.
>6.0			20–40	Rippable	Moderate.

of the whole mapping unit.

based on the estimated engineering properties of soils shown in tables 8, 9, and 10, on test data for soils in this survey area and others nearby, and on the experience of engineers and soil scientists with the soils of Jackson County Area. In tables 11 through 13, ratings are used to summarize limitation or suitability of the soils. Table 14 lists those features not to be overlooked in planning, installation, and maintenance of water control measures.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties are generally favorable for the rated use, or in other words limitations are minor and easily overcome. *Moderate* means some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability, used in tables 11 and 13, is rated by

TABLE 11.—*Sanitary facilities*

["Percs slowly" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Aaberg:					
Ab[1]:					
Aaberg part	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope	Poor: too clayey.
Barishman part	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Moderate: slope	Poor: too clayey.
Agneston:					
Ag	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: slope	Poor: small stones, slope.
Badland:					
Ba.					
Not rated.					
Bangston:					
Bg	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Fair: too sandy.
Blackwell:					
Bk	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Blevinton:					
Bn	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Fair: slope.
Boettcher:					
Bo[1]:					
Boettcher part	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight	Poor: too clayey.
Bundyman part	Severe: percs slowly, depth to rock.	Moderate: slope	Severe: too clayey, depth to rock.	Slight	Fair: too clayey.
Bosler:					
Bs	Slight	Severe: seepage	Severe: seepage	Slight	Fair: thin layer.
Bowen:					
Bw	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: seepage, slope.	Poor: small stones, slope, area reclaim.
Brinkert:					
Bx[1]:					
Brinkert part	Moderate: slope, percs slowly.	Severe: slope	Slight	Moderate: slope	Fair: too clayey, slope.
Morset part	Moderate: percs slowly, slope.	Severe: slope	Slight	Moderate: slope	Fair: slope.
Buffmeyer:					
By	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: small stones.
Cabin:					
Ca	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Fair: large stones.
Chedsey:					
Cd	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope	Poor: too clayey.

TABLE 11.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Coalmont:					
Cf[1]:					
Coalmont part	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope	Poor: too clayey.
Fluetsch part	Moderate: slope	Severe: seepage, slope.	Slight	Moderate: slope	Fair: slope.
Cowdrey:					
CoD	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Slight	Poor: too clayey.
CoF	Severe: percs slowly, slope.	Severe: slope	Severe: too clayey, slope.	Severe: slope	Poor: too clayey, slope.
Crespin:					
Cr, Cs[1]:					
Crespin parts	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Moderate: slope	Poor: too clayey, slope.
Carlstrom parts	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: too clayey, depth to rock.	Moderate: slope	Poor: too clayey.
Cryaquents:					
Ct	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, wetness.	Poor: wetness.
Cryorthents:					
CyF	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer.
Dobrow:					
Do	Severe: wetness, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness.
Dune land:					
Du.					
Not rated.					
Eachuston:					
Ea	Severe: wetness, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, small stones.	Severe: wetness, floods.	Poor: small stones, wetness.
Ethelman:					
EhE	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: seepage, depth to rock.	Severe: seepage	Fair: slope, thin layer.
Fleer:					
Fe	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Fluetsch:					
Fh[1]:					
Fluetsch part	Moderate: slope	Severe: seepage, slope.	Slight	Moderate: slope	Fair: slope.
Tiagos part	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage, slope.	Fair: slope.
Forelle:					
Fo	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too clayey, small stones.
Gelkie:					
GeD	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Moderate: slope	Fair: small stones, slope.

TABLE 11.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Gelkie variant: GkE	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope	Fair: thin layer, slope.
Girardot: Gn	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Gothic: GoE	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Moderate: slope	Poor: too clayey.
Grafen: Gr[1]: Grafen part	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope, seepage.	Severe: seepage, slope.	Poor: large stones, slope.
Rock outcrop part not rated.					
Grimstone: Gs[1]: Grimstone part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: slope	Poor: slope.
Siebert part	Severe: depth to rock, slope.	Severe: slope, seepage, depth to rock.	Severe: seepage, depth to rock.	Severe: seepage, slope.	Poor: thin layer, small stones, slope.
Handran: HaF	Severe: large stones, slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: large stones, slope.
Kather: KaE	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: slope	Poor: too clayey.
Larand: LaE	Moderate: large stones, slope.	Severe: slope	Severe: seepage	Severe: seepage	Poor: small stones, thin layer.
LaF	Severe: slope	Severe: slope	Severe: seepage	Severe: seepage	Poor: small stones, thin layer, slope.
Leavitt: Le	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: too clayey.
Lulude: LuE	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: slope	Poor: large stones, slope.
Lymanson: LyD	Severe: depth to rock.	Severe: depth to rock, slope.	Moderate: depth rock.	Slight	Fair: depth to rock.
MacFarlane: Ma[1]: MacFarlane part	Severe: large stones, slope.	Severe: seepage, slope, large stones.	Severe: seepage, large stones, slope.	Severe: seepage, slope.	Poor: large stones, slope.
Rock outcrop part not rated.					

TABLE 11.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Manburn: MbF	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: seepage, slope.	Poor: thin layer, slope.
Mendenhall: Me	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Mine pits and dumps: Mn. Not rated.					
Mirror: Mo[1]: Mirror part	Severe: depth to rock, slope.	Severe: seepage, slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: seepage, slope.	Poor: large stones, slope.
Rock outcrop part not rated.					
Mord: MrD	Severe: percs slowly.	Severe: slope	Slight	Moderate: slope	Fair: slope, small stones.
Morset: MsD	Moderate: percs slowly, slope.	Severe: slope	Slight	Moderate: slope	Fair: slope.
Muggins: MuE	Severe: percs slowly, slope.	Severe: slope	Moderate: too clayey, slope.	Severe: slope	Poor: too clayey, slope.
Nokhu: NoE	Severe: percs slowly.	Severe: slope	Moderate: too clayey.	Moderate: slope	Fair: too clayey, slope.
NoF	Severe: percs slowly, slope.	Severe: slope	Severe: slope	Severe: slope	Poor: slope.
Norriston: Nr	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Poor: small stones.
Owen Creek: Oc	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: too clayey.
On[1]: Owen Creek part	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: too clayey.
Norriston part	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage, slope.	Poor: small stones.
Parkview: PaF	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: slope	Severe: seepage, slope.	Poor: large stones, slope.
Peeler: PeE	Severe: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage, slope.	Poor: slope.
PeF	Severe: slope	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.

TABLE 11.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Perceton: Ph[1]: Perceton part	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: seepage, depth to rock.	Severe: seepage, slope, depth to rock.	Poor: slope.
Hyannis part	Severe: depth to rock, slope.	Severe: seepage, slope, depth to rock.	Severe: seepage, depth to rock.	Severe: seepage, slope.	Poor: small stones, slope.
Pinkham: Pr[1]: Pinkham part	Severe: slope, large stones.	Severe: seepage, slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: large stones, slope.
Rock outcrop part not rated.					
Randman: Ra	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness.
Rawah: RhD	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer.
Rock land: Rk. Not rated.					
Rock outcrop: Ro. Not rated.					
Rogert: RtE	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: seepage, slope.	Poor: small stones, thin layer, slope.
Spicerton: Sp	Severe: percs slowly, floods.	Severe: floods	Severe: too clayey, floods.	Severe: floods	Poor: too clayey.
Stumpp: St	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: wetness, floods.	Poor: too clayey.
Sudduth: SuE	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Moderate: slope	Poor: too clayey.
Tealson: Te[1]: Tealson part	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock.	Severe: seepage, slope.	Poor: thin layer, slope.
Rock land part not rated.					
Tine: Tn	Slight	Severe: seepage	Severe: seepage, slope.	Severe: seepage	Poor: thin layer.
Troutville: ToF	Severe: slope	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: large stones, slope.

TABLE 11.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Troutville:					
Tv[1]:					
Troutville part	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Poor: large stones.
Newcomb part	Moderate: slope	Severe: seepage, slope.	Severe: seepage	Severe: seepage	Fair: small stones, slope.
Walden:					
Wa	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Wichup:					
Wc	Severe: wetness, floods.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Poor: wetness, excess humus.
Yochum:					
YoF	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope.	Severe: seepage, slope.	Poor: slope, small stones.

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

the terms *good, fair,* and *poor,* which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 11 shows the degree and kind of limitations of each soil for these uses and suitability of each soil for use as daily cover for landfills.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect the absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and a shallow depth to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoons are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that depth of the sewage is 2 to 5 feet. Impervious soil at least 4 feet thick for the lagoon floor and sides is required to minimize seepage and contamination of local ground water. Soils that are very high in organic matter and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability, are deep to bedrock and a seasonal high water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal

TABLE 12.—*Building site development*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Aaberg: Ab[1]: Aaberg part	Severe: too clayey, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Barishman part	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.
Agneston: Ag	Severe: depth to rock, slope.	Severe: slope	Severe: depth to rock, slope.	Severe: slope	Severe: slope.
Badland: Ba. Not rated.					
Bangston: Bg	Severe: too sandy.	Slight	Slight	Moderate: slope	Slight.
Blackwell: Bk	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Blevinton: Bn	Moderate: slope	Severe: frost action.	Severe: frost action.	Severe: frost action, slope.	Severe: frost action.
Boettcher: Bo[1]: Boettcher part	Severe: depth to rock, too clayey.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.
Bundyman part	Severe: too clayey, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell.
Bosler: Bs	Severe: cutbanks cave, small stones.	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, low strength, frost action.
Bowen: Bw	Severe: depth to rock, small stones, slope.	Severe: slope	Severe: depth to rock, slope.	Severe: slope	Severe: slope.
Brinkert: Bx[1]: Brinkert part	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: shrink-swell, slope.
Morset part	Moderate: slope	Moderate: frost action, slope.	Moderate: slope	Severe: slope	Severe: frost action.
Buffmeyer: By	Moderate: small stones, slope.	Moderate: frost action.	Moderate: frost action.	Severe: slope	Moderate: frost action.
Cabin: Ca	Severe: small stones, cutbanks cave.	Slight	Slight	Slight	Slight.

TABLE 12.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Chedsey: Cd	Severe: too clayey, depth to rock.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Coalmont: Cf[1]: Coalmont part	Severe: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, depth to rock, slope.	Severe: shrink-swell.
Fluetsch part	Moderate: slope	Moderate: shrink-swell, frost action, slope.	Severe	Severe: slope	Moderate: shrink-swell, frost action, slope.
Cowdrey: CoD	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.
CoF	Severe: too clayey, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.
Crespin: Cr, Cs[1]: Crespin parts	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: slope, shrink-swell.	Severe: shrink-swell, low strength.
Carlstrom parts	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.
Cryaquents: Ct	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Cryorthents: CyF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Dobrow: Do	Severe: wetness, floods.	Severe: wetness, frost action, floods.	Severe: wetness, frost action, floods.	Severe: wetness, frost action, floods.	Severe: wetness, frost action, floods.
Dune land: Du. Not rated.					
Eachuston: Ea	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Ethelman: EhE	Moderate: slope, depth to rock.	Severe: frost action.	Moderate: depth to rock, slope.	Severe: slope, frost action.	Severe: frost action.
Fleer: Fe	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Fluetsch: Fh[1]: Fluetsch part	Moderate: slope	Moderate: shrink-swell, frost action, slope.	Moderate: shrink-swell, slope.	Severe: slope	Moderate: shrink-swell, frost action, slope.
Tiagos part	Moderate: slope	Moderate: frost action, slope.	Moderate: frost action, slope.	Severe: slope	Moderate: frost action, slope.

TABLE 12.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Forelle: Fo	Moderate: small, stones.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength, frost action.
Gelkie: GeD	Fair: small stones, slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope	Moderate: frost action, shrink-swell, slope.
Gelkie variant: GkE	Severe: depth to rock.	Severe: frost action.	Severe: depth to rock.	Severe: frost action, slope.	Severe: frost action.
Girardot: Gn	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Gothic: GoE	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell.
Grafen: Gr[1]: Grafen part	Severe: slope, depth to rock, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.
Rock outcrop part not rated.					
Grimstone: Gs[1]: Grimstone part	Severe: slope	Severe: frost action, slope.	Severe: frost action, slope.	Severe: frost action, slope.	Severe: frost action, low strength, slope.
Siebert part	Severe: slope, small stones, depth to rock.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Handran: HaF	Severe: large stones, slope	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: slope.
Kather: KaE	Severe: depth to rock, too clayey.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.
Larand: LaE	Severe: small stones.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
LaF	Severe: small stones, slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Leavitt: Le	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, frost action.
Lulude: LuE	Severe: depth to rock, large stones, slope.	Severe: slope	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.
Lymanson: LyD	Severe: depth to rock.	Moderate: low strength, depth to rock.	Severe: depth to rock, shrink-swell.	Moderate: low strength, slope, depth to rock.	Severe: low strength, frost action.

TABLE 12.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
MacFarlane:					
Ma[1]:					
MacFarlane part	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: slope.
Rock outcrop part not rated.					
Manburn:					
MbF	Severe: depth to rock, slope.	Moderate: depth to rock, slope.	Severe: depth to rock, slope.	Moderate: depth to rock, slope.	Severe: depth to rock, slope.
Mendenhall:					
Me	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Mine pits and dumps:					
Mn.					
Not rated.					
Mirror:					
Mo[1]:					
Mirror part	Severe: depth to rock, large stones, slope.	Severe: large stones, slope.	Severe: depth to rock, large stones, slope.	Severe: large stones, slope.	Severe: slope.
Rock outcrop part not rated.					
Mord:					
MrD	Moderate: small stones, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.
Morset:					
MsD	Moderate: slope	Moderate: frost action, slope.	Moderate: slope	Severe: slope	Severe: frost action.
Muggins:					
MuE	Severe: slope	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.
Nokhu:					
NoE	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.
NoF	Severe: slope	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.
Norriston:					
Nr	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Owen Creek:					
Oc	Moderate: depth to rock, too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell, depth to rock.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
On[1]:					
Owen Creek part	Moderate: depth to rock, too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell, depth to rock.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
Norriston part	Severe: cutbanks cave, slope.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.

TABLE 12.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Parkview: PaF	Severe: slope, depth to rock, large stones.	Severe: slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, large stones.	Severe: slope.
Peeler: PeE PeF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Perceton: Ph[1]:					
Perceton part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Hyannis part	Severe: depth to rock, small stones, slope.	Severe: slope	Severe: depth to rock, slope.	Severe: slope	Severe: slope.
Pinkham: Pr[1]:					
Pinkham part	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.
Rock outcrop part not rated.					
Randman: Ra	Severe: wetness	Severe: wetness, frost action.	Severe: wetness, frost action.	Severe: wetness, frost action.	Severe: wetness, frost action.
Rawah: RhD	Severe: depth to rock.	Slight	Severe: depth to rock.	Moderate: slope	Slight.
Rock land: Rk. Not rated.					
Rock outcrop: Ro. Not rated.					
Rogert: RtE	Severe: depth to rock, slope, small stones.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Spicerton: Sp	Severe: too clayey, floods.	Severe: shrink-swell, floods.	Severe: shrink-swell, floods.	Severe: shrink-swell, floods.	Severe: shrink-swell, floods.
Stumpp: St	Severe: too clayey, wetness, floods.	Severe: shrink-swell, floods.	Severe: shrink-swell, floods, wetness.	Severe: shrink-swell, floods, wetness.	Severe: shrink-swell, floods.
Sudduth: SuE	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.
Tealson: Te[1]:					
Tealson part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rock land part not rated.					
Tine: Tn	Severe: small stones.	Slight	Slight	Slight	Slight.

TABLE 12.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Troutville:					
ToF	Severe: large stones, slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Tv[1]:					
Troutville part	Severe: large stones.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope, large stones.
Newcomb part	Severe: cutbanks cave, small stones.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Walden:					
Wa	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Wichup:					
Wc	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.	Severe: wetness, floods, frost action.
Yochum:					
YoF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

water table is high, water seeps into the trenches and causes problems in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

Unless otherwise stated, the ratings in table 11 apply only to a depth of about 6 feet. If the trench is deeper, ratings of slight or moderate may not be valid. Site investigation is needed before a site is selected.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock, and stone content do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill during both wet and dry weather. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

In addition to these features, the soils selected for final cover of landfills should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either area-type or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility, and potential for plant growth.

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 12.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness of a high seasonal water table, the texture and consistence of soils, the tendency of soils to cave in or slough, and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 12 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indi-

TABLE 13.—*Construction materials*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Road fill	Sand	Gravel	Topsoil
Aaberg: Ab[1]:				
Aaberg part	Poor: shrink-swell, low strength, thin layer.	Unsuited	Unsuited	Poor: too clayey.
Barishman part	Poor: shrink-swell	Unsuited	Unsuited	Fair: thin layer, slope.
Agneston: Ag	Poor: thin layer	Unsuited	Unsuited	Poor: small stones, slope.
Badland: Ba. Not rated.				
Bangston: Bg	Good	Fair: excess fines	Unsuited	Poor: too sandy.
Blackwell: Bk	Poor: wetness, frost action.	Poor: excess fines	Unsuited	Poor: wetness.
Blevinton: Bn	Poor: frost action	Unsuited	Unsuited	Fair: slope.
Boettcher: Bo[1]:				
Boettcher part	Poor: shrink-swell, thin layer.	Unsuited	Unsuited	Poor: too clayey.
Bundyman part	Poor: shrink-swell, thin layer, low strength.	Unsuited	Unsuited	Poor: too clayey.
Bosler: Bs	Good	Good	Good	Fair: too clayey.
Bowen: Bw	Poor: thin layer, slope.	Unsuited: thin layer	Unsuited: thin layer	Poor: small stones, slope.
Brinkert: Bx[1]:				
Brinkert part	Fair: shrink-swell	Unsuited	Unsuited	Poor: thin layer.
Morset part	Poor: frost action	Unsuited	Unsuited	Fair: too clayey, thin layer.
Buffmeyer: By	Fair: frost action	Poor: excess fines	Poor: excess fines	Fair: slope, thin layer.
Cabin: Ca	Good	Poor: excess fines	Poor: excess fines	Fair: small stones.
Chedsey: Cd	Poor: shrink-swell, thin layer.	Unsuited	Unsuited	Fair: thin layer, slope.
Coalmont: Cf[1]:				
Coalmont part	Poor: shrink-swell, thin layer.	Unsuited	Unsuited	Poor: too clayey.
Fluetsch part	Fair: shrink-swell, frost action.	Poor: excess fines	Unsuited	Fair: slope.

TABLE 13.—*Construction materials*—Continued

Soil name and map symbol	Road fill	Sand	Gravel	Topsoil
Cowdrey:				
CoD	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer.
CoF	Poor: shrink-swell, slope, low strength.	Unsuited	Unsuited	Poor: slope.
Crespin:				
Cr[1]:				
Crespin part	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey.
Carlstrom part	Poor: shrink-swell, thin layer.	Unsuited	Unsuited	Poor: too clayey.
Cs[1]:				
Crespin part	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, large stones.
Carlstrom part	Poor: shrink-swell, thin layer.	Unsuited	Unsuited	Poor: too clayey, large stones.
Cryaquents:				
Ct	Poor: wetness, frost action.	Unsuited	Unsuited	Poor: wetness.
Cryorthents:				
CyF	Poor: slope, thin layer.	Unsuited	Unsuited	Poor: slope, thin layer.
Dobrow:				
Do	Poor: wetness	Fair: excess fines	Good	Poor: wetness.
Dune land:				
Du.				
Not rated.				
Eachuston:				
Ea	Poor: wetness, frost action.	Good	Good	Poor: wetness, small stones.
Ethelman:				
EhE	Poor: frost action, thin layer.	Unsuited: thin layer	Unsuited	Fair: slope, area reclaim.
Fleer:				
Fe	Poor: wetness, frost action.	Fair: excess fines	Fair: excess fines	Poor: wetness.
Fluetsch:				
Fh[1]:				
Fluetsch part	Fair: shrink-swell, frost action.	Poor: excess fines	Unsuited	Fair: slope.
Tiagos part	Fair: frost action	Unsuited	Unsuited	Fair: slope.
Forelle:				
Fo	Fair: shrink-swell	Unsuited	Unsuited	Fair: too clayey.
Gelkie:				
GeD	Fair: frost action	Poor: excess fines	Poor: excess fines	Poor: small stones.
Gelkie variant:				
GkE	Poor: thin layer	Unsuited: thin layer	Unsuited: thin layer	Fair: small stones, slope.
Girardot:				
Gn	Poor: wetness, frost action.	Unsuited	Unsuited	Poor: wetness.
Gothic:				
GoE	Poor: shrink-swell.	Unsuited	Unsuited	Fair: thin layer, slope.

TABLE 13.—*Construction materials*—Continued

Soil name and map symbol	Road fill	Sand	Gravel	Topsoil
Grafen:				
Gr[1]:				
Grafen part	Poor: slope, large stones, thin layer.	Unsuited: large stones.	Unsuited	Poor: large stones, slope.
Rock outcrop part not rated.				
Grimstone:				
Gs[1]:				
Grimstone part	Poor: thin layer, frost action.	Unsuited	Unsuited	Poor: area reclaim, slope.
Siebert part	Poor: thin layer	Unsuited	Unsuited	Poor: small stones, too sandy, slope.
Handran:				
HaF	Poor: large stones, slope.	Unsuited: large stones.	Unsuited: large stones.	Poor: large stones, slope.
Kather:				
KaE	Poor: shrink-swell, thin layer.	Unsuited	Unsuited	Poor: too clayey.
Larand:				
LaE	Good	Poor: large stones	Poor: large stones	Fair: small stones, slope.
LaF	Poor: slope	Poor: large stones	Poor: large stones	Poor: slope.
Leavitt:				
Le	Fair: shrink-swell, low strength, frost action.	Unsuited	Unsuited	Fair: too clayey.
Lulude:				
LuE	Poor: thin layer	Unsuited: thin layer	Unsuited: thin layer	Poor: large stones, slope.
Lymanson:				
LyD	Poor: thin layer, frost action, low strength.	Unsuited	Unsuited	Poor: small stones.
MacFarlane:				
Ma[1]:				
MacFarlane part	Poor: slope	Unsuited: large stones.	Unsuited: large stones.	Poor: large stones, slope.
Rock outcrop part not rated.				
Manburn:				
MbF	Poor: thin layer, slope.	Unsuited	Unsuited	Poor: small stones, slope.
Mendenhall:				
Me	Poor: wetness	Poor: excess fines	Unsuited	Poor: wetness.
Mine pits and dumps:				
Mn.				
Not rated.				
Mirror:				
Mo[1]:				
Mirror part	Poor: thin layer, large stones, slope.	Unsuited: large stones.	Unsuited: large stones.	Poor: thin layer, slope.
Rock outcrop part not rated.				

TABLE 13.—*Construction materials*—Continued

Soil name and map symbol	Road fill	Sand	Gravel	Topsoil
Mord: MrD	Poor: shrink-swell	Unsuited	Unsuited	Fair: small stones, slope.
Morset: MsD	Poor: frost action	Unsuited	Unsuited	Fair: too clayey, thin layer.
Muggins: MuE	Poor: shrink-swell	Unsuited	Unsuited	Poor: slope.
Nokhu: NoE	Poor: shrink-swell	Unsuited	Unsuited	Fair: thin layer, slope.
NoF	Poor: shrink-swell, slope.	Unsuited	Unsuited	Poor: slope.
Norriston: Nr	Good	Poor: excess fines	Fair: excess fines	Poor: small stones.
Owen Creek: Oc	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Fair: thin layer.
On[1]: Owen Creek part	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Fair: thin layer.
Norriston part	Good	Poor: excess fines	Fair: excess fines	Poor: small stones.
Parkview: PaF	Poor: slope, large stones.	Unsuited	Unsuited	Poor: large stones, slope.
Peeler: PeE	Fair: slope, frost action.	Poor: excess fines	Poor: excess fines	Poor: small stones, slope.
PeF	Poor: slope	Poor: excess fines	Poor: excess fines	Poor: small stones, slope.
Perceton: Ph[1]: Perceton part	Poor: thin layer	Unsuited: thin layer	Unsuited	Poor: slope.
Hyannis part	Poor: thin layer	Unsuited: thin layer	Unsuited: thin layer	Poor: small stones, slope.
Pinkham: Pr[1]: Pinkham part	Poor: slope	Poor: large stones	Unsuited	Poor: large stones, slope.
Rock outcrop part not rated.				
Randman: Ra	Poor: wetness	Good	Good	Poor: wetness.
Rawah: RhD	Poor: thin layer	Unsuited	Unsuited	Fair: small stones.
Rock land: Rk. Not rated.				
Rock outcrop: Ro. Not rated.				

TABLE 13.—*Construction materials*—Continued

Soil name and map symbol	Road fill	Sand	Gravel	Topsoil
Rogert: RtE	Poor: thin layer	Unsuited: thin layer	Unsuited: thin layer	Poor: small stones, slope.
Spicerton: Sp	Poor: shrink-swell	Unsuited	Unsuited	Poor: too clayey.
Stumpp: St	Fair: wetness	Fair: excess fines	Fair: excess fines	Poor: too clayey, excess salt.
Sudduth: SuE	Poor: shrink-swell	Unsuited	Unsuited	Fair: too clayey, slope.
Tealson: Te[1]: Tealson part	Poor: thin layer	Unsuited	Unsuited	Poor: slope.
Rock land part not rated.				
Tine: Tn	Good	Fair: excess fines	Fair: excess fines	Poor: small stones.
Troutville: ToF	Poor: slope	Unsuited	Unsuited	Poor: small stones, slope.
Tv[1]: Troutville part	Fair: large stones	Unsuited	Unsuited	Poor: small stones.
Newcomb part	Good	Fair: excess fines	Fair: excess fines	Fair: thin layer, small stones, slope.
Walden: Wa	Poor: wetness	Fair: excess fines	Fair: excess fines	Poor: wetness.
Wichup: Wc	Poor: wetness, excess humus.	Poor: excess fines	Poor: excess fines	Poor: wetness.
Yochum: YoF	Poor: slope, thin layer.	Unsuited: thin layer	Unsuited: thin layer	Poor: small stones, slope.

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

cate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 12 have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly of asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load-supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action indicate the traffic-supporting capacity. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones, all of which affect stability and ease of excavation, were also considered.

The suitability of each soil as a source of road fill, sand, gravel, and topsoil is indicated in table 13. The texture and thickness of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed and described as the survey is made, generally about 6 feet.

Road fill is soil material used in embankments for roads. Soils are evaluated as sources of road fill for

low embankments, generally less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings apply to the soil profile between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table 8 provide more specific information about the nature of each horizon that can help determine its suitability for road fill.

The ease of excavation is determined by the thickness of the borrow material, wetness, stones, and slope. The performance of the material is influenced by grain size, shrink-swell potential, and frost action.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 13 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 9.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to sustain the growth of plants. Also considered is the damage that would result to the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slopes, and amount of stones. The ability of the soil to sustain plant growth is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the surface layer greatly increases the absorption and retention of moisture and nutrients. Therefore, careful preservation and use of material from this layer is desirable.

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 14 soil and site features that affect use are indicated for each kind of soil.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for this use have low seepage potential, which is determined by the permeability and depth over fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and is of favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Aquifer-fed excavated ponds are bodies of water created by excavating a pit or dugout into a groundwater aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 14 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability, texture, structure, depth to claypan or other layers that influence rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, salinity and alkalinity, and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments, or a combination of channels and ridges, constructed across a slope to intercept runoff and allow the water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity of slope and steepness, depth to bedrock or other unfavorable material, permeability, ease of establishing vegetation, and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff at nonerosive velocities to outlets. Features that affect the use of soils for waterways are slope, permeability, erodibility, and suitability for permanent vegetation.

Formation and classification of the soils[6]

In this section the factors that affect the formation of the soils in Jackson County Area are discussed. Then the soils are classified.

Factors of soil formation

Soil is a natural body occurring at the surface of the earth. Its characteristics are the result of the action of the environment upon parent material over time. Because it is a dynamic body, the character of the soil differs from place to place, depending on the nature and intensity of the factors that control its development.

Five major factors influence the development of the soil in its virgin state at any given location (*6*): parent material, climate, living organisms, relief, and time. Each of these factors is highly complex. There are many kinds of climate and many combinations of biological forces. Parent materials differ greatly in physical, chemical, and mineralogical properties, and

[6] Based on material by ARVAD J. CLINE, senior soil correlator, retired, Soil Conservation Service.

TABLE 14.—*Water*

["Seepage" and some of the other terms that describe restrictive soil features

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds
Aaberg:			
Ab[1]:			
Aaberg part	Slope, depth to rock	Compressible, low strength	No water
Barishman part	Slope	Hard to pack, compressible, shrink-swell.	No water
Agneston:			
Ag	Seepage, slope, depth to rock.	Thin layer	No water
Badland:			
Ba.			
Bangston:			
Bg	Seepage, slope	Piping, seepage	No water
Blackwell:			
Bk	Seepage	Erodes easily	Favorable
Blevinton:			
Bn	Seepage, slope	Piping	No water
Boettcher:			
Bo[1]:			
Boettcher part	Slope, depth to rock	Thin layer, hard to pack, compressible.	No water
Bundyman part	Slope, depth to rock	Low strength, shrink-swell, compressible.	No water
Bosler:			
Bs	Seepage	Seepage	No water
Bowen:			
Bw	Seepage, depth to rock, slope.	Thin layer, seepage	No water
Brinkert:			
Bx[1]:			
Brinkert part	Slope	Compressible, hard to pack, shrink-swell.	No water
Morset part	Slope, seepage	Low strength	No water
Buffmeyer:			
By	Seepage, slope	Seepage	No water
Cabin:			
Ca	Seepage, slope	Favorable	No water
Chedsey:			
Cd	Slope, depth to rock	Shrink-swell, thin layer, low strength.	No water
Coalmont:			
Cf[1]:			
Coalmont part	Slope, depth to rock	Thin layer, hard to pack	No water
Fluetsch part	Seepage, slope, shrink-swell.	Seepage, piping	No water
Cowdrey:			
CoD, CoF	Slope	Shrink-swell, low strength, compressible.	No water

management

are defined in the Glossary. Absence of an entry means soil was not evaluated]

Drainage	Irrigation	Terraces and diversions	Grassed waterways
		Depth to rock, percs slowly, slope.	
Percs slowly	Percs slowly, slope	Percs slowly, slope	Percs slowly, slope.
		Depth to rock, slope	Slope.
Not needed	Slope, seepeage, erodes easily	Slope, erodes easily	Slope, erodes easily.
Floods, frost action, wetness	Wetness, floods	Erodes easily, wetness	Wetness.
Favorable	Slope	Slope, piping	Slope, erodes easily.
Percs slowly	Slope, percs slowly	Slope, percs slowly	Slope, percs slowly.
Percs slowly, depth to rock, slope.	Percs slowly, slope, depth to rock.	Percs slowly, slope, depth to rock.	Percs slowly, slope.
Slope	Slope, droughty	Favorable.	
		Slope, depth to rock	Slope.
Percs slowly, slope	Slope, percs slowly	Slope, percs slowly.	
Frost action	Slope	Favorable	Slope.
		Favorable	Slope.
Favorable	Slope, seepage	Erodes easily, piping	Slope, erodes easily.
		Slope, percs slowly, depth to rock.	Slope, percs slowly.
Percs slowly	Slope, percs slowly	Slope, percs slowly	Slope, percs slowly.
Favorable	Slope	Slope, piping	Slope.
		Percs slowly, slope	Percs slowly, slope.

TABLE 14.—*Water*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds
Crespin:			
Cr, Cs [1]:			
Crespin parts	Slope	Shrink-swell, compressible, low strength.	No water
Carlstrom parts	Slope	Shrink-swell, compressible, low strength.	No water
Cryaquents:			
Ct	Seepage	Piping	Favorable
Cryorthents:			
CyF	Slope	Thin layer	No water
Dobrow:			
Do	Seepage	Seepage	Favorable
Dune land:			
Du.			
Eachuston:			
Ea	Seepage	Seepage	Favorable
Ethelman:			
EhE	Seepage, depth to rock	Piping, erodes easily, thin layer.	No water
Fleer:			
Fe	Seepage	Seepage	Favorable
Fluetsch:			
Fh [1]:			
Fluetsch part	Seepage, slope, shrink-swell.	Seepage, piping	No water
Tiagos part	Seepage, slope	Piping	No water
Forelle:			
Fo	Seepage	Piping	No water
Gelkie:			
GeD	Slope, seepage	Piping	No water
Gelkie variant:			
GkE	Slope, depth to rock, seepage.	Thin layer	No water
Girardot:			
Gn	Shrink-swell	Piping	Slow refill
Gothic:			
GoE	Slope	Shrink-swell, low strength, hard to pack.	No water
Grafen:			
Gr [1]:			
Grafen part	Seepage, slope, large stones	Seepage, large stones	No water
Rock outcrop part not rated.			
Grimstone:			
Gs [1]:			
Grimstone part	Seepage, slope, depth to rock.	Compressible, low strength	No water
Siebert part	Seepage, slope	Thin layer	No water
Handran:			
HaF	Seepage, slope	Large stones, seepage	No water

management—Continued

Drainage	Irrigation	Terraces and diversions	Grassed waterways
		Percs slowly, slope.	
		Percs slowly, slope, depth to rock.	
		Wetness	Wetness.
		Slope, depth to rock.	
Wetness, floods, frost action	Wetness, floods	Wetness, floods	Wetness.
Floods, frost action, wetness	Wetness, floods	Wetness	Wetness.
Depth to rock, slope	Slope, rooting depth	Piping, erodes easily, slope	Erodes easily, slope.
Floods, frost action	Seepage, wetness, floods	Wetness, frost action	Wetness, floods.
Favorable	Slope	Slope, piping	Slope.
		Slope, piping	Slope.
Slope	Slope	Favorable.	
Slope	Slope, droughty	Droughty.	
Depth to rock, frost action	Slope	Depth to rock, erodes easily	Slope, erodes easily.
Wetness, floods, frost action	Wetness, floods	Piping, wetness	Wetness.
Percs slowly, slope	Percs slowly, slope	Percs slowly	Percs slowly, slope.
		Large stones, slope	Large stones, slope.
		Depth to rock, erodes easily	Slope, erodes easily.
		Erodes easily, slope	Erodes easily, slope.
		Large stones, slope	Large stones, slope.

TABLE 14.—*Water*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds
Kather: KaE	Slope, depth to rock	Compressible, shrink-swell, thin layer.	No water
Larand: LaE, LaF	Seepage, slope	Seepage	No water
Leavitt: Le	Seepage	Shrink-swell, low strength, piping.	No water
Lulude: LuE	Slope, depth to rock	Thin layer, large stones	No water
Lymanson: LyD	Depth to rock, slope	Thin layer, low strength	No water
MacFarlane: Ma [3]: MacFarlane part	Slope, seepage	Large stones	No water
Rock outcrop part not rated.			
Manburn: MbF	Slope, depth to rock	Thin layer, seepage	No water
Mendenhall: Me	Seepage	Seepage, piping	Favorable
Mine pits and dumps: Mn.			
Mirror: Mo [1]: Mirror part	Slope, depth to rock, seepage.	Thin layer, slope	No water
Rock outcrop part not rated.			
Mord: MrD	Slope	Hard to pack, shrink-swell	No water
Morset: MsD	Slope, seepage	Low strength	No water
Muggins: MuE	Slope	Shrink-swell, hard to pack	No water
Nokhu: NoE, NoF	Slope	Low strength, shrink-swell.	No water
Norriston: Nr	Seepage, slope	Seepage	No water
Owen Creek: Oc		Low strength, shrink-swell, thin layer.	No water
On [1]: Owen Creek part		Low strength, shrink-swell, thin layer.	No water
Norriston part	Seepage, slope	Seepage	No water
Parkview: PaF	Seepage, slope	Large stones	No water
Peeler: PeE, PeF	Seepage, slope	Seepage	No water

management—Continued

Drainage	Irrigation	Terraces and diversions	Grassed waterways
Percs slowly	Slope, percs slowly	Percs slowly, depth to rock	Percs slowly.
		Complex slope	Slope.
Slope	Slope	Favorable.	
		Large stones, slope	Large stones, slope.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	
		Large stones, slope	Slope, large stones.
		Slope, depth to rock	Slope.
Floods, wetness, frost action	Wetness, floods	Wetness	Wetness.
		Large stones	Slope.
Percs slowly, slope	Slope, slow intake	Percs slowly, slope	Percs slowly, slope.
Frost action	Slope	Favorable	Slope.
		Slope, percs slowly	Slope, percs slowly.
Percs slowly, slope	Percs slowly, slope	Percs slowly, slope	Percs slowly, slope.
		Slope	Droughty, slope.
		Depth to rock, percs slowly.	
		Depth to rock, percs slowly.	
		Slope	Droughty, slope.
		Large stones, slope	Large stones, slope.
		Slope	Slope.

TABLE 14.—*Water*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds
Perceton:			
Ph[1]:			
Perceton part	Seepage, slope	Favorable	No water
Hyannis part	Seepage, slope	Seepage, thin layer	No water
Pinkham:			
Pr[1]:			
Pinkham part	Slope, seepage	Seepage, large stones	No water
Rock outcrop part not rated.			
Randman:			
Ra	Seepage	Seepage	Favorable
Rawah:			
RhD	Slope, depth to rock	Thin layer, low strength	No water
Rock land:			
Rk.			
Rock outcrop:			
Ro.			
Rogert:			
RtE	Depth to rock, slope	Thin layer	No water
Spicerton:			
Sp	Slope	Hard to pack, compressible	No water
Stumpp:			
St	Slope	Hard to pack	Slow refill
Sudduth:			
SuE	Slope	Low strength, shrink-swell, compressible.	No water
Tealson:			
Te[1]:			
Tealson part	Slope, depth to rock	Thin layer	No water
Rock land part not rated.			
Tine:			
Tn	Slope, seepage	Seepage	No water
Troutville:			
ToF	Slope, seepage	Large stones, low strength	No water
Tv[1]:			
Troutville part	Seepage	Large stones, low strength	No water
Newcomb part	Slope, seepage	Seepage	No water
Walden:			
Wa	Slope, seepage	Seepage	Favorable
Wichup:			
Wc	Seepage, excess humus	Seepage, piping, excess humus.	Favorable
Yochum:			
YoF	Slope, depth to rock, seepage.	Seepage	No water

[1] This mapping unit is made up of two dominant kinds of soil. See mapping unit description for the composition and behavior

management—Continued

Drainage	Irrigation	Terraces and diversions	Grassed waterways
		Slope, depth to rock	Slope.
		Large stones, slope	Droughty, small stones.
		Slope, large stones	Slope, large stones.
Wetness, frost action	Seepage, wetness	Wetness	Wetness.
Depth to rock	Slope, rooting depth	Slope, depth to rock	Slope.
		Depth to rock, slope	Droughty, slope.
Percs slowly, excess salt, floods.	Percs slowly, floods, excess salt	Percs slowly	Percs slowly, excess salt.
Percs slowly, frost action, excess salt.	Excess salt, percs slowly, wetness.	Wetness, percs slowly	Percs slowly, wetness, excess salt.
Percs slowly	Percs slowly, slope	Percs slowly, slope	Percs slowly, slope.
		Depth to rock, slope	Slope.
		Slope	Slope, droughty.
		Slope, large stones	Slope, large stones.
		Slope, large stones	Slope, large stones.
		Slope	Slope, droughty.
Wetness, frost action	Floods, wetness	Wetness	Wetness.
		Wetness, piping	Wetness.
		Slope, depth to rock	Slope.

of the whole mapping unit.

there are great differences in the length of time that these forces have been active.

Although these factors have been traditionally accepted as those that influence soil development, a sixth factor—man and his activities—must be added. Man alters the character of the soil by such physical processes as mixing, removal, and fertilization, and he alters the soil's natural environment by controlling water movement and plant cover.

The history of the development of soil characteristics and the study of the interactions of the formative forces is called soil genesis. The characteristics themselves constitute soil morphology. The color of a soil is one part of the soil's morphology; the reason that such a color developed is part of the soil's genesis.

It is impossible to precisely reconstruct the history of a soil's development from the limited data available at any one location. To do so, it would be necessary to observe the soil and its environment throughout the entire period of its development, which in most cases is several thousand years. Since this is impossible, any reconstruction of the soil's genesis must be based on interpretation of the soil's morphology and the accumulated knowledge of how such morphology could most logically have developed.

Following is a general evaluation of the factors that influence soil development in Jackson County Area.

Parent material

Because it is mountainous, Jackson County Area contains a wide variety of parent materials. The chemical, physical, and mineralogical characteristics of the parent materials constitute the base properties on which the soil-forming processes operate; they are important to the understanding of soil genesis.

Evaluation of the soil parent materials relative to the changes that are introduced by soil genesis can be made only at each specific location. General observations about characteristics of some parent materials in the Area can be made, but such observations do not adequately characterize the parent material for any specific soil.

Recent flood plain alluvium is recent alluvial deposits on flood plains and low terraces. The material varies widely from place to place in color, texture, reaction, and mineralogy. It also displays wide variations in these properties vertically within the profile. The irregular distribution of organic carbon from stratum to stratum makes recent alluvium unique among parent materials.

Old terrace alluvium and glacial outwash were deposited by torrential and subdued melt water from receding valley glaciers. The deposits vary in depth, texture, and mineralogy because of differences in source material—fine textured shales to coarse textured granites—and in stream velocity. The deposits are on the floor of the park generally well above the present streams. They are mostly underlain by gravel and cobbles laid down during a torrential period of deposition that was followed by a more subdued period of deposition. In Jackson County Area, most of these deposits are moderately fine textured and medium textured to a depth of 2 feet. Much of the material is calcareous in the lower part of the profile. Content of organic matter is highest in the surface layer and decreases uniformly with depth.

Fan deposits were formed by old erosion cycles. They are a result of erosion of very old, high, dissected landscapes. The fan deposits formed on the lower, or newer, level of topography. Most soils on these deposits contain free carbonate above a depth of 60 inches but have been in place long enough to develop prominent horizons.

Glacial till, a product of local valley glaciers, is extensive in Jackson County Area. The till is in the form of outwash plains, eskers, and moraines. It ranges in texture from fine to coarse. Most of the material is derived from crystalline igneous or metamorphic rocks, but there is also evidence that some of the material is from fine textured sedimentary rocks. The till from crystalline igneous rocks is coarse textured and noncalcareous. It is filled with cobbles and stones, and in many places it has much rock at the surface. The till from sedimentary rocks is generally fine textured and is calcareous in places. This material was deposited during at least four glaciation-erosion cycles.

Residuum from crystalline and sedimentary rocks has weathered in place or has been only locally transported from the bedrock. The soils that formed in residuum from crystalline rocks are generally shallow, stone filled, moderately coarse textured, and slightly acid to neutral. Those that formed in residuum from schist and gneiss are generally moderately coarse textured, medium textured, or moderately fine textured, are neutral to mildly alkaline, and have a relatively high content of mica. Those that formed in residuum from sedimentary rocks are deep or moderately deep, medium textured to fine textured, neutral to alkaline, and calcareous.

Climate

Jackson County Area has a semiarid, continental climate. Temperature and precipitation vary greatly with changes in elevation and location. Elevation ranges from slightly below 8,000 feet at the lowest point in the Area to above 12,000 feet on the mountain peaks. Temperatures in the Area become colder, and annual precipitation increases, as elevation increases. Generally, the temperature and precipitation change gradually as elevation gradually increases from the center of the floor to the outer edge of North Park, and they change rapidly as elevation rapidly increases from the edge of the park to the mountain peaks.

The mean annual air temperature at Walden, near the center of the Area at an elevation of 8,100 feet, is 37.1° F. The mean soil temperature in summer there is about 58° F. The mean annual air temperature above timberline in the southeastern part of the Area (about 11,000 feet) is about 26°, and the mean soil temperature in summer is about 43°.

Soil temperature has a pronounced effect on the activity of biological, chemical, and physical forces that affect soil genesis. When the soil temperature is near or below 32°, chemical reactions in the soil are slowed greatly and mechanical movement by freezing and thawing is at a maximum.

Organisms are slowed greatly, though still active,

when soil temperature drops to 41° or below. At Walden the period during which the soil temperature at a depth of 20 inches is 41° or above is about 184 days. At Muddy Pass, in the southwestern part of the Area at an elevation of 8,800 feet, this period is 125 days, and above 11,000 feet it is less than 90 days.

The effectiveness of precipitation in providing soil moisture depends on many factors other than amount. At lower elevations, the soils lose moisture because humidity is low, rainfall intensities are high, and runoff is rapid. Soils are warmer for longer periods at lower elevations, so soil-forming processes are active for longer periods than at high elevations. High elevations receive more precipitation, mostly as snow; slopes are steep; and the soil is cold for long periods. Runoff in spring is rapid because of snow melt, shallowness of the soils, Rock outcrop, and steep slopes.

Living organisms

Plants and animals are extremely important in the development of soils. Micro-organisms, bacteria, small burrowing animals, worms, insects, and fungi help to weather rock and decompose organic matter. Plants add organic matter, which in turn is acted upon by micro-organisms. This action influences the structure and physical condition of the soil.

The floor of North Park supports grass-brush vegetation, and stands of timber grow on the surrounding mountainsides. This pattern of grass-brush and timber (fig. 17) has existed for a long time and is reflected in the morphology of the soils.

In Jackson County Area, the grass-brush vegetation produces soils 12 to 24 inches thick that are characterized by a friable, granular, humus-enriched surface layer. The entire profile is commonly neutral to alkaline in reaction. If the soil formed in calcareous parent material, the mature profile is underlain by distinct horizons of calcium carbonate accumulation.

Minor differences in the soil commonly result from differences in production of the grass-brush vegetation. On steep soils, runoff is rapid and less moisture is available; therefore, the grass-brush cover is thin and less productive. In these areas the soil-forming processes act more slowly. The rate of decomposition of organic matter nearly equals the rate of return of organic matter to the soil. Thus, the horizons are thinner and content of organic matter is low.

The opposite effect takes place where water has accumulated in the soil and production of vegetation is

Figure 17.—**Dobrow loam under grasses; Hyannis soils under forest.**

high. There, the soil tends to be thicker, the surface layer is darker, and there is more organic matter in the soil.

The transition from grass-brush vegetation to forest vegetation is generally abrupt. However, narrow transitional areas occur in some places. Under transitional conditions, the soil generally has a moderately thick, dark surface layer as do the grass-brush soils, but it also has a thin, light colored eluvial A2 horizon immediately above a B2t horizon as do the timbered soils.

At higher elevations, timber stands are dense and the understory of grasses, forbs, and shrubs is sparse. Soil moisture is plentiful in these areas, and the profile is generally thicker than under grass-brush vegetation. Conifer needles, twigs, and bark make up most of the organic matter that falls on the soil. These decompose slowly and under acid conditions.

Soils that form under timber have only a very thin dark colored surface mineral layer, if there is one. They are characterized by a moderately thick, light colored, eluvial A2 horizon. The mature profile has a B2t horizon of silicate clay illuviation, is slightly acid to strongly acid, and lacks accumulation of calcium carbonate. Typically, these soils have a horizon between the A2 horizon and the B2t horizon that consists of seams and nodules of material similar to the B2t horizon embedded in material similar to the A2 horizon. Although the genesis of this horizon has not been adequately explained, it appears that part of the B2t horizon is changing into an A2 horizon.

A small part of Jackson County Area is above the timberline. These are areas of alpine grassland in which the plants differ from those in the warmer lower elevations of North Park. In the alpine areas the surface layer receives yearly additions of organic matter, which decomposes under acid conditions. Temperatures are very cold, and periods of decomposition are relatively short. Soils in these areas are characterized by a moderately thick, dark colored, very acid, granular surface layer that is high in organic matter content. It is underlain by a bright colored B2 horizon in which some iron has accumulated.

The effect of animal life on the soils in Jackson County Area is not easily distinguished. This does not mean that animals have no effect in soil genesis, but their effect is local or is approximately uniform on most of the soils in the Area. Soils in most areas show some evidence of mixing by earthworms, ants, or burrowing rodents.

Relief

The shape and the slope of any part of a landscape affect soil genesis. Physical features influence water movement, soil temperature, wind movement, and geologic or accelerated erosion.

The amount of water that enters the soil influences both kind and degree of soil genesis. Any factor that regulates the entry of water into the soil or its movement within the soil is equally important. In a large part of Jackson County Area soil moisture is in short supply for at least part of each growing season. Consequently, the amount of water that can be stored when moisture is available is important. In nearly level areas from which runoff is minimal, in concave areas that collect runoff, and in areas below soils from which runoff is high, water is available for increased plant growth, leaching, and storage. Such areas tend to have thicker horizons, to be deeply leached, and to be darker in color.

Landform and, more importantly, direction of slope influence soil temperature. Slopes that face the sun are warmer than those that are sheltered from the sun's rays during much of the day. This effect is pronounced in the high mountain areas, where the sun's heat on the soil counteracts cold air currents.

The effect of relief in controlling wind currents is not well understood, and observations generally apply only to local conditions. Most noticeable in this Area is the effect of relief on the accumulation of snow in winter. In some alpine areas, accumulation of snow may prevent plant growth. In others it may provide differing amounts of soil moisture and so influence the kind of vegetation that will grow.

Some wearing away of sediment from all parts of the landscape is normal and is called geologic erosion. The intensity of each erosive process increases as slope and concentration of runoff increases. Consequently, on some parts of the landscape the natural rate of removal of soil material exceeds the rate of soil formation. Under these conditions a mature soil can never develop.

Time

If the kind and magnitude of all other forces of soil formation are equal, the parts of a given landscape that have been subjected to the soil-forming forces for the longest time will have the strongest degree of soil development. It is difficult, however, to determine the chronological age of a soil, because the soil-forming processes are not uniform. The degree of horizon differences displayed by one profile may have resulted from differences in the intensity of the other factors rather than from differences in age; consequently, degree of development alone is not a reliable indication of the soil's age.

Unless the soil can be specifically dated by archeological means or by measuring the decay of radioactive substances, the soil scientist relies on geomorphic evaluation of the landscape to arrive at relative ages and general relationships for the particular landscapes. In such comparisons, care should be exercised in the interpretation of chronological age from the degree of soil genesis. Genetically young soils often occur in deposits of great age in which geologic erosion, for example, has affected the soil's genesis. Advanced stages of development can be considered as indicating the relative age of soils.

In the mountain and valley topography of Jackson County Area, for the most part, the forces of geologic erosion are active. Cycles are of relatively short duration, and landforms shaped by one cycle may be obliterated or highly dissected by subsequent cycles. Only a trained observer can reconstruct the landscape of any one period in time.

Classification of the soils

Classification consists of an orderly grouping of

soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The system of classification used by the National Cooperative Soil Survey was developed in the early sixties and adopted in 1965 (*5*). It is under continual study (*8*). This system has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

The entire system is arrayed into several levels of generalization. Each succeeding level is more detailed than the previous one. Thus the series level, which is the most detailed level of generalization, uses many soil properties as differentiating criteria, but the order level, which is the least detailed, uses comparatively few and broad differences.

The stratified array of series that results from their grouping at all levels of generalization provides a means for discussing, studying, and using soil survey information for a variety of purposes and intensities. For the most detailed use of soil information, the soil series is most efficient. For less detailed purposes the grouping at the family or subgroup level may be adequate. For still more general uses of soil information, such as comparison of these soils to those in other parts of the United States or the world, the great group, suborder, or order level may be the best to use.

In table 15, the soil series of the Jackson County Area are classified. Classes of the system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized. The differentiae for the orders are based on the kind and degree of the dominant soil-forming processes that have gone on. Each order is named with a word of three or four syllables ending in *sol*. An example is Entisol.

SUBORDER: Each order is divided into suborders that are based primarily on properties that influence soil genesis and that are important to plant growth or that were selected to reflect what seemed to be the most important variables within the orders. The name of a suborder has two syllables. The last syllable indicates the order. An example is Orthents.

GREAT GROUP: Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of horizons, in soil moisture and temperature regimes, and in base status. The name of a great group has three or four syllables and ends with the name of a suborder. A prefix added to the name suggests something about the properties and soil. An example is Cryorthent.

SUBGROUP: Each great group is divided into three kinds of subgroups: the central (typic) concept of the great group (not necessarily the most extensive subgroup); the intergrades, which are transitional forms to other orders, suborders, or great groups; and extragrade subgroups that have some properties that are representative of the great group but that do not indicate transitions to any other known kind of soil. The name of a subgroup is derived by placing one or more adjectives before the name of the great group. The adjective *Typic* is used for the subgroup that is thought to typify the great group. An example is Typic Cryorthent.

FAMILY: Soil families group soils within a subgroup that have similar enough physical and chemical properties that responses to management and manipulation for use are nearly the same for comparable phases. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineralogy, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for particle size, mineralogy, reaction, and so on that are used as family differentiae. An example is fine, montmorillonitic, nonacid Typic Cryorthent.

SERIES: The series consists of a group of soils that formed in a particular kind of parent material and have horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition. The name is a place name taken from the area where the soil was first defined. An example is Crespin series.

General nature of the area

This section briefly describes the natural resources and the history and development of Jackson County Area. It also discusses physiography and geology, climate, and markets and transportation. Much of the Area is locally known as North Park.

Natural resources

Oil, coal, fluorspar, and other minerals are located in Jackson County Area. In 1890 coal of good grade was discovered 18 miles south of Walden. Coal was first mined commercially about 1909 around Coalmont. There are still large quantities in reserve in the Coalmont Formation. Oil and natural gas are produced on both the eastern and the western sides of North Park. Fluorspar was first discovered in 1918. Deposits near Northgate and on the eastern side of the park have been mined and milled intermittently for many years, and fluorspar production is a major industry in Jackson County. Some copper and gold have been discovered in the Area, and platinum was

TABLE 15.—*Classification of the soils*

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil series	Family	Subgroup	Order
Aaberg	Fine, montmorillonitic	Borollic Vertic Camborthids	Aridisols.
Agneston	Loamy-skeletal, mixed	Typic Cryoboralfs	Alfisols.
Bangston	Sandy, mixed	Typic Cryoborolls	Mollisols.
Barishman	Fine, montmorillonitic	Borollic Vertic Paleargids	Aridisols.
Blackwell	Fine-loamy, mixed	Typic Cryaquolls	Mollisols.
Blevinton	Coarse-loamy, mixed	Cryic Paleborolls	Mollisols.
Boettcher	Fine, montmorillonitic	Borollic Haplargids	Aridisols.
Bosler	Fine-loamy over sandy or sandy-skeletal, mixed	Borollic Haplargids	Aridisols.
Bowen	Loamy-skeletal, mixed	Argic Cryoborolls	Mollisols.
Brinkert	Fine, montmorillonitic	Argic Cryoborolls	Mollisols.
Buffmeyer	Loamy-skeletal, mixed	Mollic Cryoboralfs	Alfisols.
Bundyman	Fine, montmorillonitic	Borollic Camborthids	Aridisols.
Cabin	Fine-loamy over sandy or sandy-skeletal, mixed	Argic Cryoborolls	Mollisols.
Carlstrom	Fine, montmorillonitic, nonacid	Typic Cryorthents	Entisols.
Chedsey	Fine, montmorillonitic	Mollic Cryoboralfs	Alfisols.
Coalmont	Fine, montmorillonitic	Borollic Paleargids	Aridisols.
Cowdrey	Fine, montmorillonitic	Typic Cryoboralfs	Alfisols.
Crespin	Fine, montmorillonitic, nonacid	Typic Cryorthents	Entisols.
Cryaquents	---	---	Entisols.
Cryorthents	---	---	Entisols.
Dobrow	Coarse-loamy, mixed	Cumulic Cryaquolls	Mollisols.
Eachuston	Sandy-skeletal, mixed	Typic Cryaquents	Entisols.
Ethelman	Coarse-loamy, mixed	Argic Cryoborolls	Mollisols.
Fleer	Coarse-loamy, mixed (calcareous)	Cumulic Cryaquolls	Mollisols.
Fluetsch	Fine-loamy, mixed	Borollic Haplargids	Aridisols.
Forelle	Fine-loamy, mixed	Borollic Haplargids	Aridisols.
Gelkie	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Gelkie variant	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Girardot	Fine-loamy, mixed (calcareous)	Typic Cryaquepts	Inceptisols.
Gothic	Fine, montmorillonitic	Argic Cryoborolls	Mollisols.
Grafen	Loamy-skeletal, mixed	Typic Cryoborolls	Mollisols.
Grimstone	Fine-loamy, mixed	Typic Cryoboralfs	Alfisols.
Handran	Loamy-skeletal, mixed	Typic Cryoborolls	Mollisols.
Hyannis	Loamy-skeletal, mixed	Psammentic Cryoboralfs	Alfisols.
Kather	Fine, montmorillonitic	Borollic Haplargids	Aridisols.
Larand	Loamy-skeletal, mixed	Typic Cryoboralfs	Alfisols.
Leavitt	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Lulude	Loamy-skeletal, mixed	Typic Cryoboralfs	Alfisols.
*Lymanson	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
MacFarlane	Loamy-skeletal, mixed	Typic Cryoboralfs	Alfisols.
Manburn	Loamy, mixed, shallow	Borollic Haplargids	Aridisols.
Mendenhall	Coarse-loamy, mixed (calcareous)	Cumulic Cryaquolls	Mollisols.
Mirror	Loamy-skeletal, mixed	Pergelic Cryumbrepts	Inceptisols.
Mord	Fine, montmorillonitic	Boralfic Cryoborolls	Mollisols.
Morset	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Muggins	Fine, montmorillonitic	Typic Cryoboralfs	Alfisols.
Newcomb	Sandy-skeletal, mixed	Typic Cryochrepts	Inceptisols.
Nokhu	Fine, montmorillonitic	Typic Cryoboralfs	Alfisols.
Norriston	Loamy-skeletal, mixed	Argic Cryoborolls	Mollisols.
Owen Creek	Fine, montmorillonitic	Argic Cryoborolls	Mollisols.
Parkview	Loamy-skeletal, mixed	Argic Cryoborolls	Mollisols.
Peeler	Fine-loamy, mixed	Typic Cryoboralfs	Alfisols.
Perceton	Fine-loamy, mixed	Typic Cryoboralfs	Alfisols.
Pinkham	Medial over loamy-skeletal, mixed	Typic Cryothods	Spodosols.
Randman	Fine-loamy over sandy or sandy-skeletal, mixed	Argic Cryaquolls	Mollisols.
Rawah	Fine-loamy, mixed	Borollic Haplargids	Aridisols.
Rogert	Loamy-skeletal, mixed	Lithic Cryoborolls	Mollisols.
Siebert	Loamy-skeletal, mixed	Psammentic Cryoboralfs	Alfisols.
Spicerton	Fine, montmorillonitic	Borollic Natrargids	Aridisols.
Stumpp	Clayey over sandy or sandy-skeletal, montmorillonitic.	Natric Cryoborolls	Mollisols.
Sudduth	Fine, montmorillonitic	Argic Pachic Cryoborolls	Mollisols.
Tealson	Loamy, mixed, shallow	Typic Cryoborolls	Mollisols.
Tiagos	Coarse-loamy, mixed	Argic Cryoborolls	Mollisols.
Tine	Sandy-skeletal, mixed	Typic Cryoborolls	Mollisols.
Troutville	Loamy-skeletal, mixed	Psammentic Cryoboralfs	Alfisols.
Walden	Fine-loamy over sandy or sandy-skeletal, mixed	Typic Cryaquolls	Mollisols.
Wichup	Coarse-loamy, mixed	Histic Cryaquolls	Mollisols.
Yochum	Loamy-skeletal, mixed	Psammentic Cryoboralfs	Alfisols.

discovered in 1949. Gravel is abundant and has been used locally for road surfacing.

Lumbering, the second largest industry in Jackson County Area, relies on the forests within the survey area and, to a larger extent, on the adjacent national forests. At one time railroad ties and mine props were cut and milled by small portable sawmills. Today milling is generally done by central, permanent sawmills.

History and development

Jackson County Area was off the main east-west trails of the early 19th century. Thus the area was not well traveled, and permanent settlers were slow to make their homes in such an isolated place.

From 1820 on, some travel by white men in the Area is recorded. They were mostly mountain men and explorers, including Ceran St. Vrain, Jacques Laramie, John C. Fremont, and Jim Bridger. The first permanent white settler was James O. Pinkham, who built a log house on Pinkham Creek in 1874. In 1878, J. S. Fordyce wintered the first cattle in the Area. Silver was discovered at Teller in 1879, and by the early 1880's the Area was well settled.

Teller City was the first community in the Area. It had a brief, hectic life as a mining camp. In 1909 Jackson County was formed from part of Larimer County, with Walden as county seat.

Today Jackson County Area is one of the most stable ranching areas in Colorado. In 1974 there were 112 ranches in Jackson County. A ranch typically has 3,300 acres of deeded range, 1,000 acres of irrigated hayland, 150 acres of irrigated pasture, and a grazing permit for 500 animal-unit-months on publicly owned range. Public range is managed by the Bureau of Land Management, the National Forest, or the State Land Board.

Ranching operations in this Area are almost entirely cow-calf, cow-calf-steer, or occasionally cow-calf-sheep. In 1971, according to State statistics, there were 51,000 head of cattle and calves in Jackson County.

The mountain meadows are vital to ranching. The hay and pasture from the meadows feed the cattle more than half of the year. Hay production in 1971 was 77,000 tons and averaged 1.18 tons per acre. Some ranchers sell excess hay to buyers in eastern Colorado.

The Colorado State Forest, which is managed by the State Land Board, covers 70,819 acres. It has produced about 10,000,000 board feet of lumber. A recreational area is being developed by the Colorado Department of Natural Resources, Division of Parks.

Walden is the only incorporated town. Other towns are Cowdrey, Gould, Coalmont, and Rand. Population of Jackson County was 500 in 1900, 1,340 in 1920, and 1,714 in 1970.

Physiography and geology[7]

North Park, which makes up most of Jackson County Area, is a broad topographic and structural basin. It has a comparatively flat floor of about 1,000 square miles surrounded by mountains that rise 2,000 to 5,000 feet above the basin floor. Elevation within the survey area ranges from about 7,800 feet along the North Platte River where it leaves the park to 12,965 feet on Clark Peak. The larger part of the survey area, the floor of North Park, lies between 8,000 and 8,400 feet.

The eastern boundary of North Park is formed in part by the southern end of Medicine Bow Range and in part by Never Summer Range. The crests of these two mountain ranges are marked by a series of sharp, ragged peaks 11,000 feet to nearly 13,000 feet in altitude. The Rabbit Ears Range along the south side of the basin and the Park Range along the west side have a number of prominent peaks 11,000 to 12,000 feet in altitude. Independence Mountain, a relatively low east-west ridge, forms part of the northern boundary of North Park.

Physiography

North Park and the adjacent mountains form the watershed of the North Platte River, which flows out the northern end of the park. Major tributaries of the North Platte River include the Canadian, Michigan, and Illinois Rivers on the east side of the park and Grizzly Creek, Roaring Fork, and North Fork on the west side.

The larger streams in North Park meander through broad flood plains, which are largely used as hay meadows. Stream terraces are as much as 200 feet above the stream channels and flank most of the flood plains. In places these terraces are irrigated and used as hay meadows.

The floor of North Park, except the stream valleys, consists of low, rolling topography. Soft sedimentary rocks lie under most of the area. The plant cover is sagebrush and grass.

Around the edges of the basin, the prevailing flatness of the park floor is broken by several sharp ridges and low mountains. One of the most prominent is the long hogback ridge in the northwestern part of the park. It rises 1,000 to 1,500 feet above the park floor. This ridge is approximately parallel to the eastern edge of the Park Range and is separated from it by the valley of North Fork North Platte River. The ridge is broken by two gaps. One of them separates Sheep Mountain from Boettcher Ridge on the north. The other gap is cut by North Fork between Sheep Mountain and Delaney Butte on the south.

Sentinel Mountain, a conspicuous feature in the northeast corner of the park, rises 1,200 to 1,500 feet above the surrounding valleys. The mountain is somewhat ridge-shaped, and its long axis extends southeastward.

Johnny Moor Mountain is a low, irregularly shaped mountain between the Canadian and Michigan River valleys on the east side of the park.

A large timber-covered ridge, Owl Ridge, separates the valleys of the Michigan and Illinois Rivers. Owl Mountain rises to about 2,000 feet above the adjacent valleys. The ridge extends northwestward from the western end of Owl Mountain and gradually decreases in elevation toward the west to about 400 feet near the center of the park, where it is cut by the Illinois River. West of the Illinois River, it is known as Peterson Ridge and is 300 to 500 feet above the park

[7] By ALEX D. ELKIN, geologist, Soil Conservation Service.

floor to a point a few miles from Delaney Butte. The ridge ends abruptly near the junction of Grizzly Creek and Roaring Fork.

In the southwestern part of the park between the valleys of Little Grizzly Creek and Grizzly Creek is a comparatively rugged area, the principal features of which are Mexican Ridge and Pole Mountain. The highest points of these hills are 900 to 1,200 feet above the nearby valleys.

Geology

Rocks of all major geologic ages occur in Jackson County Area. They include Precambrian metamorphic and igneous rocks; sedimentary rocks of Paleozoic, Mesozoic, and Tertiary age; volcanic rocks of Tertiary age; and unconsolidated surface deposits of Quaternary age. The floor of the North Park structural basin is underlain by several thousand feet of sedimentary rocks, largely of Mesozoic and Tertiary age. The mountains surrounding the basin are mainly igneous and metamorphic crystalline rocks of Precambrian age.

The main structural development of the North Park basin occurred during the Laramide revolution near the close of the Mesozoic and into early Tertiary time. Erosion associated with the uplift of the areas surrounding the basin removed the Paleozic and Mesozoic sedimentary cover in these areas and exposed the Precambrian basement rocks. Deposition of sediment in the basin continued through the Tertiary Period. In late Tertiary time volcanic activity occurred throughout the southern part of the basin. The present physiography of North Park has been shaped largely in Quaternary time by the action of streams, glaciers, and wind.

Pre-Quaternary bedrock

The principal divisions of the bedrock formations in Jackson County Area are (1) Precambrian crystalline rocks such as hornblende schist, a gneiss complex, and quartz monzonite; (2) Permian and Triassic sedimentary rocks such as the Satanka Shale, Forelle Limestone, and Chugwater Formation; (3) Jurassic and Lower Cretaceous sedimentary rocks such as the Sundance Formation, Morrison Formation, and Dakota Group; (4) Upper Cretaceous sedimentary rocks such as the Benton Shale, Niobrara Formation, and Pierre Shale; (5) Paleocene and Eocene sedimentary rocks of the Coalmont Formation; (6) Oligocene and Miocene sedimentary rocks of the White River Formation and North Park Formation; (7) Tertiary intrusive rocks, mainly quartz monzonite porphyry; and (8) Tertiary extrusive rocks consisting of tuffs, agglomerates, breccias, and lava flows.

The Precambrian rocks crop out mainly in the northern part of the survey area in the vicinity of Independence Mountain, Boettcher Ridge, and Sheep Mountain. The rocks consist primarily of a metamorphic complex of hornblende gneisses and schists. Dikes of quartz monzonite have intruded extensively into these metamorphic rocks.

The older sedimentary formations of Permian to Late Cretaceous age occur mainly in discontinuous outcrops along the western and eastern margins of the survey area. The rocks of Permian and Triassic age, mostly the Chugwater Formation, crop out over only relatively small areas within North Park. They consist chiefly of impure red shales, siltstones, and sandstones; their maximum thickness is more than 800 feet. The Jurassic and Lower Cretaceous rocks (Sundance Formation, Morrison Formation, and Dakota Group) are a series of sandstone, siltstone, shale, and minor limestone beds, the maximum thickness is about 900 feet. The Upper Cretaceous rocks (Benton Shale, Niobrara Formation, and Pierre Shale) consist of dark-gray noncalcareous shale, light gray to yellow calcareous shale, some thin sandstone, and minor limestone and bentonite beds; the maximum thickness is nearly 7,000 feet.

The Coalmont Formation, of Paleocene and Eocene age, is the most wide-spread formation in the survey area and forms more than three-fourths of the park floor. The formation is as thick as 9,000 feet. The lower part of the Coalmont Formation consists of alternating beds of white to buff sandstone and dark gray carbonaceous shale. The sandstone predominates. Several thick coal beds also occur in the lower part of the formation. The upper part of the Coalmont Formation is mainly soft arkosic sandstone.

The White River Formation, of Oligocene age, and the North Park Formation, of Miocene age, crop out along the North Park syncline, a structural depression that extends from Owl Mountain on the east to Delaney Butte on the west, and in areas adjoining the North Park basin on the north. The rocks of the White River Formation are mainly white, light gray, greenish gray, or tan tuffaceous silt beds containing variable amounts of intermixed clay and sand. The North Park Formation is mostly light gray to light brown calcareous sandstone, but includes much conglomeratic sandstone and lesser amounts of shale, bentonitic clay, volcanic ash, and tuff.

Intrusive and extrusive igneous rocks of middle or late Tertiary age crop out along the southern margins of the survey area. The intrusive rocks are mainly light-colored porphyry dikes; they are similar to quartz monzonite in composition. The extrusive rocks consist of a variety of volcanic rocks including tuffs, agglomerates, breccias, and lava flows that range from quartz latite to basalt in composition.

Quaternary deposits

The Quaternary is the current period of geologic time and includes the Pleistocene and Recent Epochs. The Pleistocene Epoch is marked by evidence of repeated worldwide glacial advances in the higher latitudes, fluctuations of sea level, and the appearance and migration of many existing species of plants and animals. The Recent Epoch includes roughly the time since the retreat of the last Pleistocene ice sheet.

Deposits of Quaternary age in the Area consist primarily of unconsolidated materials of varying proportions of clay, silt, sand, gravel, cobbles, and boulders. These materials weathered from bedrock and were subsequently transported and redeposited by colluvial, alluvial, glacial, or eolian processes.

The extent and nature of these Quaternary deposits were largely controlled by the cyclical changes in climate that were responsible for the worldwide glacial and interglacial intervals of the Pleistocene

Epoch. There were four major glacial-interglacial cycles. There is also evidence of one or more minor climatic cycles during each of the major glacial intervals. The major glacial intervals of the midcontinental region are the Nebraskan, Kansan, Illinoian, and Wisconsin Glaciations.

Colluvial, alluvial, glacial, and eolian deposits of the Wisconsin Glaciation together with those of the Recent Epoch make up the largest part of the Quaternary deposits in the survey area. The three major glacial-interglacial cycles preceding the Wisconsin are represented only by scattered remnants of deposits that were once probably quite widespread. Because of the limited extent of these older deposits and the difficulty in definitely determining their age, they are best described under the general term pre-Wisconsin.

Many of the valleys which drain the mountains rimming North Park were occupied by glacial ice repeatedly during the Pleistocene. Four, and possibly five, intervals of glaciation have been distinguished in the glacial deposits of these valleys. The oldest of these glaciations is represented by weathered glacial till that was deposited by piedmont glaciers that extended several miles in front of the mountains. The deposits are characterized by lack of morainal form and advanced degree of weathering. Deep limonite staining is common.

Glacial moraines representing two major glacial advances, both probably of Wisconsin age, occur along most of the larger mountain valleys bordering the survey area. The older of the two moraines can generally be distinguished from the younger by physiographic position, by a more subdued morainic topography, and by a greater degree of weathering.

A striking feature of the topography of the basin floor of North Park is the great number of terraces along the larger stream valleys. At least six major terrace levels can be distinguished along most of the valleys. These surfaces are about 20 feet to more than 200 feet above the stream channels. They are generally underlain by sandy and gravelly alluvial deposits that average about 10 feet in thickness. The two lowest terraces, about 20 feet and 40 feet above the stream, can be traced upstream to glacial moraines, probably of Wisconsin age. The higher terraces are probably pre-Wisconsin in age, although they cannot be correlated with specific glacial advances.

Alluvial deposits of Recent age are in the flood plains of many of the small streams and all of the larger streams.

In the northeastern part of North Park, several areas of considerable size are covered by wind-blown sand, which in two places has drifted up the steep slope at the foot of the Medicine Bow Range forming conspicuous dune areas that are barren of vegetation. One of these areas is immediately north of East Sand Creek near Ute Pass and is somewhat less than 1 square mile in extent. The other conspicuous sand dune area lies several miles northwest, north of North Sand Creek. A large part of an area several square miles in extent lying northwest, west, and southwest of the northernmost sand dune area is covered by sand as thick as several feet. Eolian sand is present in this part of North Park and not elsewhere, probably because the prevailing winds are southwesterly. These winds not only transport fine sand across the park floor but also carry it up the northeast slope of the valley of the Canadian River.

Colluvial deposits occur throughout the survey area. The slope-wash mantle on steep to gently sloping hillsides is probably the most widespread of the surface deposits in the area. Talus, frost rubble, and landslide deposits are present in a few small areas.

Climate and its effect on soil use

The climate of Jackson County Area is continental and is typical of the high Rocky Mountain valleys. It is characterized by abundant sunshine, low relative humidity, low precipitation, and wide daily and seasonal variations in temperature.

Walden and Spicer are the only weather stations in Jackson County that have reasonably complete data (table 16). The climate at Walden is typical of much of the area. Precipitation is less there than in areas of higher elevation.

Two characteristics of climate have great effect on farming in the Area. An extremely short frost-free

TABLE 16.—*Temperature and precipitation data*

Walden station

[Town of Walden; elevation, 8,100 feet; length of record, 14 years]

Month	Average temperature	Average precipitation	Average snowfall
	°F	In	In
January	15.3	0.54	8.0
February	18.2	.42	6.6
March	25.1	.71	9.0
April	36.4	.92	6.0
May	45.4	1.10	2.8
June	53.0	1.12	(1)
July	59.0	.98	(1)
August	57.0	1.03	(1)
September	49.8	.98	.2
October	40.4	.67	2.7
November	25.9	.50	6.4
December	20.2	.50	7.2
Year	37.1	9.47	48.9

Spicer station

[2 miles northeast of Spicer; elevation, 8,300 feet; length of record, 18 years]

January	15.9	0.98	12.3
February	19.7	.95	13.1
March	25.5	1.37	15.4
April	35.7	1.65	15.9
May	44.7	1.30	6.3
June	52.3	1.04	(1)
July	59.3	1.21	(1)
August	57.3	1.34	(1)
September	50.2	1.09	.9
October	40.5	.93	5.2
November	26.7	1.00	12.0
December	20.8	1.23	15.8
Year	37.4	14.09	96.9

[1] Trace.

season, 15 to 45 days, limits the choice of crops in the Area mainly to meadow hay, pasture, and barley or oat hay.

The other factor is low annual precipitation. Irrigation is necessary for production of hay and pasture, except in a marginal area near the Wyoming State line in which nonirrigated winter wheat is grown. Closely connected with climate is the effect of temperature on the formation of an organic mat on irrigated hay meadow. Within 3 years after irrigation is begun, an organic mat 1 inch to 3 inches thick forms on the meadow. This mat reduces yields on most meadows, but is advantageous on soils that are severely affected by alkali.

Annual precipitation ranges from about 9 inches at the center of the Area, at Walden, to about 65 inches at Clark Peak, the highest point in the Area. The precipitation pattern at Walden is such that about two-thirds falls as rain during the growing season, while higher in the mountains about two-thirds falls as snow in winter.

Winter snowfall, like the annual precipitation, is least at the center of the Area. Generally, less than 1 foot of snow lies on the ground most of the winter. At the snow survey course on Cameron Pass in the southeast corner of the Area, the depth of snow in spring is more than 100 inches. Spring snowmelt brings flooding to the river bottoms and low terraces. Grass and sod cover generally hold soil erosion to a minimum.

Summer is cool, and the temperature at night is near freezing. The average low at Walden from June through September is 36.3° F (*9*). The daytime temperature in summer seldom exceeds 90°, and the daily average high at Walden from June through September is 72.6°. Winter is cold; there are long periods during which the temperature does not rise above freezing in daytime. The average daytime high from November through February is 32.4°, and the average low at night is 9.3°. Lows of 50° below zero are not uncommon at Walden.

Markets and transportation

There are no markets in Jackson County Area for livestock, hay, lumber, and mining products. These must be shipped out of the Area by rail or truck. The county is served by State Highways 14, 125, and 127. The Union Pacific Railroad runs a line from Laramie, Wyoming, into the Area. There is no commercial passenger rail service into or out of the Area.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpine. Above timberline, implying high elevation and cold climate.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Compressible. Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which

a lump can be crushed by the fingers. Terms commonly used to describe consistance are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Duff. The matted, partly decomposed organic surface layer on forested soils.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which are originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep,

well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lithochromic. Having color directly inherited from the parent rock.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. Inadequate strength for supporting loads.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Park. A grassy, wide, and comparatively level open valley in wooded mountains.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.05 to 0.002 millimeter); and clay (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a

series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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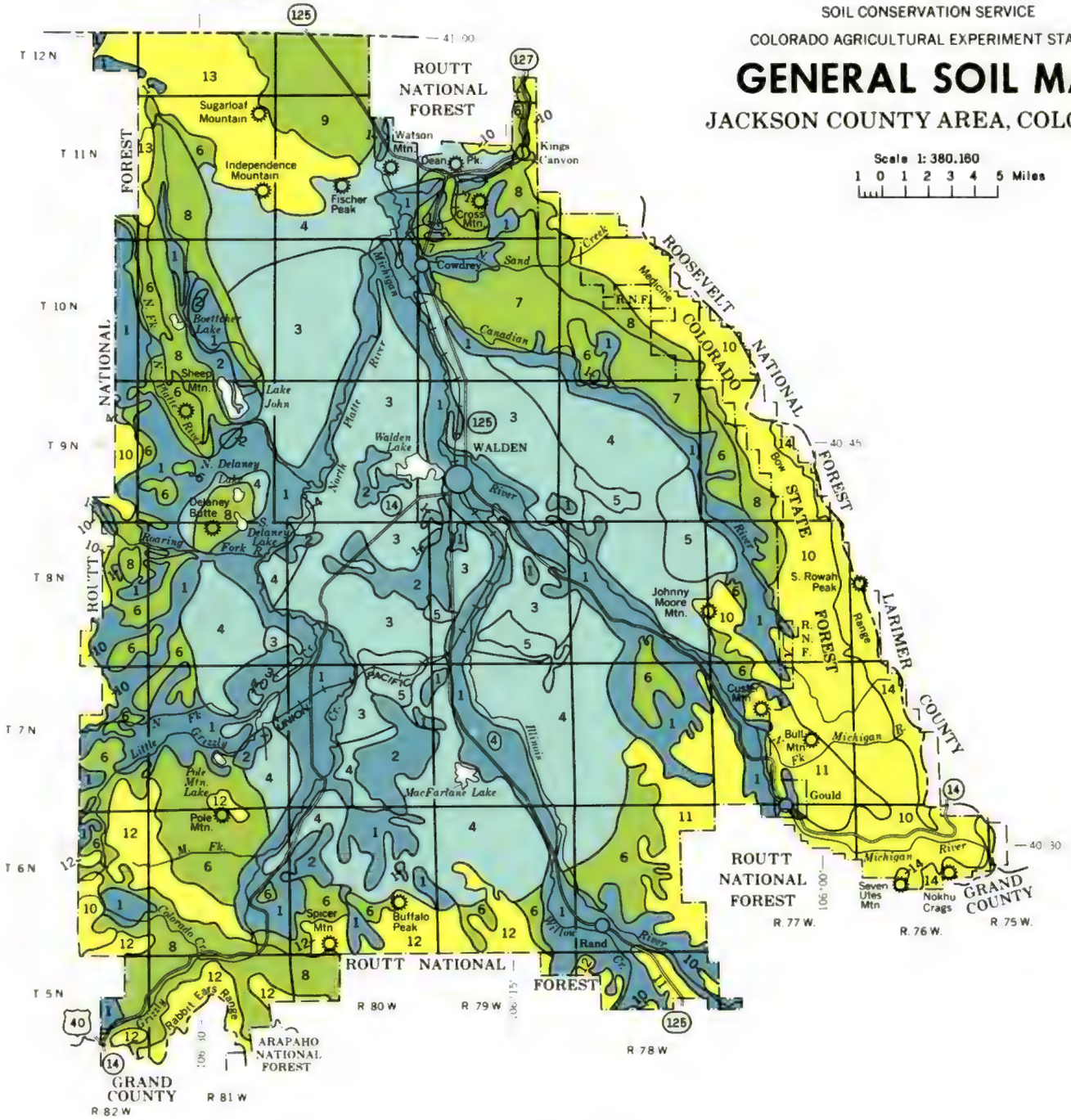
WYOMING



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
COLORADO AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

JACKSON COUNTY AREA, COLORADO

Scale 1: 380,160
1 0 1 2 3 4 5 Miles

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SOIL ASSOCIATIONS*

SOILS ON LOW TERRACES, ON FLOOD PLAINS, IN UPLAND DEPRESSIONS, AND ON IRRIGATED BENCHES

1 — Randman-Blackwell-Dobrow association. Deep, poorly drained, dominantly sandy loams and loams that formed in alluvium and outwash; in some, very gravelly sand is at a depth of less than 40 inches; on low terraces, flood plains, and benches; slopes of 0 to 5 percent.

2 — Spicerton-Stumpp association. Deep, well drained to somewhat poorly drained sandy loams and clay loams that formed in alluvium; on flood plains, on low terraces, and in upland depressions; contain excess salts that affect plant growth; slopes of 0 to 5 percent.

SOILS ON BENCHES AND UPLANDS

3 — Fluetsch-Bosler-Tealson association. Deep and shallow, well drained sandy loams that formed in old alluvium, glacial outwash, and material weathered from sandstone; mainly on uplands, high terraces, and benches; slopes of 2 to 30 percent.

4 — Tiagos-Cabin association. Deep, well drained fine sandy loams and sandy loams that formed in alluvium; in some, very gravelly sand is at a depth of less than 40 inches; on high terraces, benches, outwash terraces, alluvial fans, and uplands; slopes of 2 to 20 percent.

5 — Coalmont-Brinkert-Aaberg association. Moderately deep over soft shale and deep, well drained and moderately well drained loams and clays that formed in old alluvium and material weathered from shale; on uplands and high alluvial fans; slopes of 3 to 15 percent.

SOILS ON HIGH TERRACES, MOUNTAIN FOOT SLOPES, AND SANDY UPLANDS

6 — Gelkie-Blevington-Leavitt association. Deep, well drained, dominantly sandy loams and loams that formed in eolian sand, old alluvium, and glacial outwash; on valley sides, high terraces, benches, outwash plains, and alluvial fans; slopes of 2 to 40 percent.

7 — Bangston-Tine association. Deep, well drained and somewhat excessively drained fine sands and sandy loams that formed in alluvium and eolian sand; on upland terraces and outwash plains; slopes of 1 to 10 percent.

8 — Crespin-Sudduth-Gothic association. Deep, well drained, dominantly loams and clays that formed in glacial till, alluvium, and material weathered from shale; on uplands, mountainsides, valley sides, and fans; slopes of 0 to 20 percent.

9 — Owen Creek-Rogert-Ethelman association. Moderately deep and shallow, well drained sandy loams and gravelly sandy loams that formed in material weathered from sandstone and granite; on mountainsides and uplands; slopes of 0 to 25 percent.

SOILS ON MOUNTAINS

10 — Pinkham-MacFarlane Rock outcrop association. Deep, well drained, dominantly very stony and stony sandy loams that formed in glacial till; and Rock outcrop; on moraines on mountainsides; slopes of 10 to 60 percent.

11 — Nokhu-Lulude-Perceton association. Deep and moderately deep, well drained loams, cobbly loams, and sandy loams that formed in outwash, alluvium, and material weathered from sandstone and basalt; mainly on glacial terraces and mountainsides; slopes of 0 to 50 percent.

12 — Peeler-Cowdrey-Perceton association. Deep and moderately deep, well drained, dominantly loams and sandy loams that formed in glacial till, old alluvium, and material weathered from sandstone; mainly on mountainsides; slopes of 4 to 40 percent.

13 — Grimstone-Agneston-Bowen association. Moderately deep, well drained, dominantly gravelly sandy loams and sandy loams that formed in material weathered from mica schist, granite, and gneiss; mainly on mountainsides; slopes of 5 to 45 percent.

14 — Rock outcrop-Mirror association. Rock outcrop, and moderately deep, well drained gravelly sandy loams that formed in material weathered from gneiss and schist; on mountainsides above timberline; slopes of 10 to 40 percent.

*Terms for texture refer to the surface layer of the major soils.

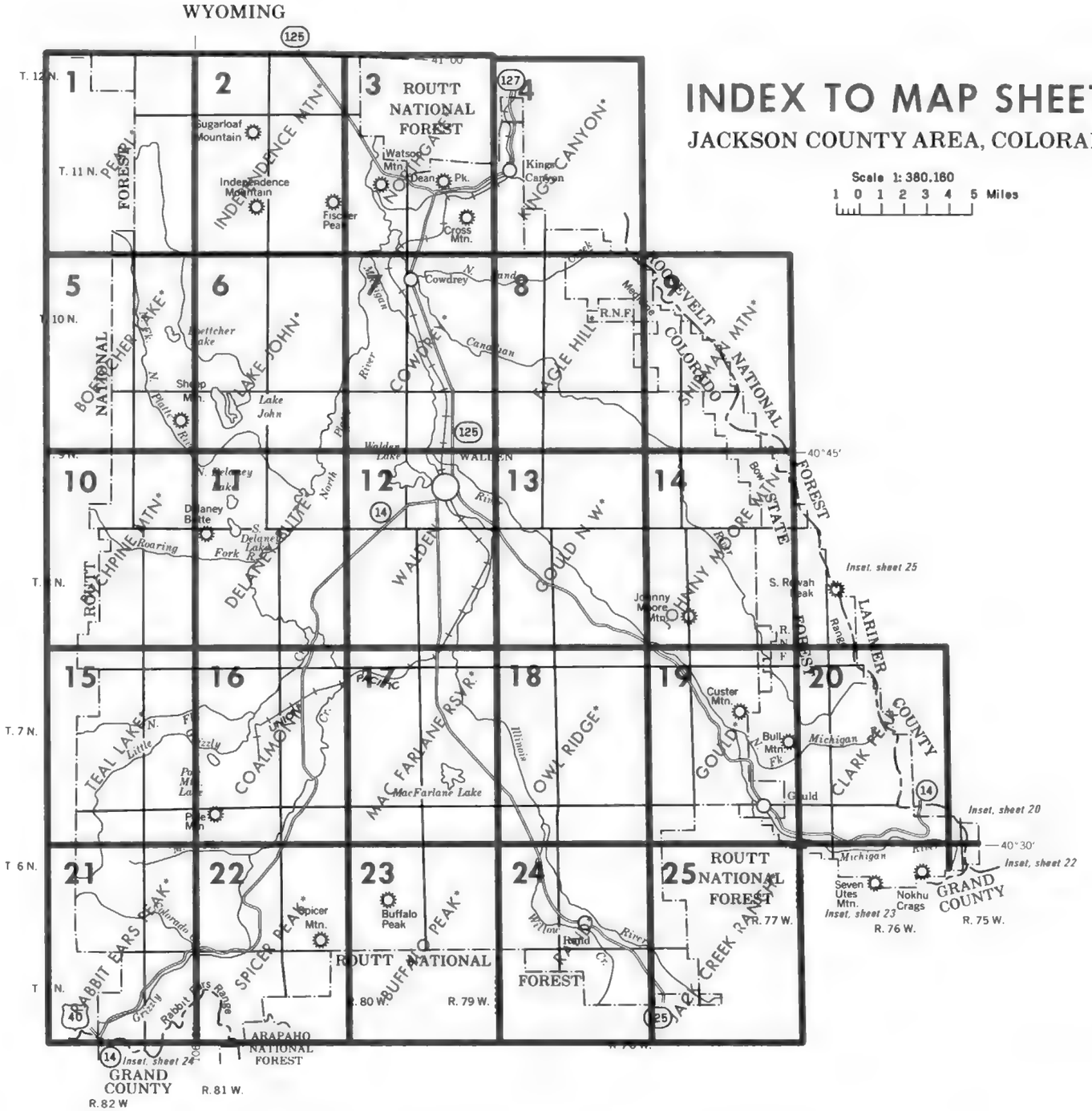
Compiled 1980

INDEX TO MAP SHEETS

JACKSON COUNTY AREA, COLORADO

Scale 1: 380,160

1 0 1 2 3 4 5 Miles



*QUADRANGLE NAME

SOIL LEGEND

The first letter, always a capital, is the initial letter of the map unit. A second capital letter D, E, or F indicates slope class. Most symbols without a slope class letter are for those of nearly level soils, but some are for complexes, associations, or land types that have a considerable range in slope

SYMBOL	NAME
Ab	Aaberg-Barrishman association
Ag	Agneston gravelly coarse sandy loam, 5 to 40 percent slopes
Ba	Badland
Bg	Bangston fine sand, 1 to 10 percent slopes
Bk	Blackwell loam
Bn	Blevinton sandy loam, 8 to 20 percent slopes
Bo	Boettcher-Bundyman association
Bs	Bosler sandy loam
Bw	Bowen gravelly sandy loam, 15 to 45 percent slopes
Bx	Brinkert-Morset association
By	Buffmeyer sandy loam, 4 to 18 percent slopes
Ca	Cabin sandy loam
Cd	Chedsey loam, 5 to 12 percent slopes
Cf	Coalmont-Fluetsch complex
CoD	Cowdrey loam, 4 to 10 percent slopes
CoF	Cowdrey loam, 10 to 50 percent slopes
Cr	Crespin-Carlstrom clays
Cs	Crespin-Carlstrom stony clays
Ct	Cryaquents
CyF	Cryorthents, steep
Do	Dobrow loam
Du	Dune land
Ea	Eachuston gravelly loam
EhE	Ethelman sandy loam, 0 to 25 percent slopes
Fe	Fleer loam
Fh	Fluetsch-Tiagos association
Fo	Forelle loam
GeD	Gelkie sandy loam, 2 to 15 percent slopes
GkE	Gelkie sandy loam, moderately deep variant, 0 to 25 percent slopes
Gn	Girardot silty clay loam
GoE	Gothic loam, 0 to 20 percent slopes
Gr	Grafen-Rock outcrop complex
Gs	Grimstone-Siebert association
HaF	Handran extremely stony sandy loam, 20 to 40 percent slopes
KaE	Kather clay loam, 5 to 20 percent slopes
LaE	Larand fine sandy loam, 3 to 25 percent slopes
LaF	Larand fine sandy loam, 25 to 40 percent slopes
Le	Leavitt loam
LuE	Lulude cobbly loam, 10 to 25 percent slopes
LyD	Lymanson cobbly loam, 4 to 10 percent slopes
Ma	MacFarlane-Rock outcrop association
MbF	Manburn gravelly coarse sandy loam, 10 to 40 percent slopes
Me	Mendenhall loam
Mn	Mine pits and dumps
Mo	Mirror-Rock outcrop complex
MrD	Mord loam, 4 to 15 percent slopes
MsD	Morset loam, 1 to 15 percent slopes
MuE	Muggins loam, 5 to 30 percent slopes
NoE	Nokhu loam, 0 to 25 percent slopes
NoF	Nokhu loam, 25 to 50 percent slopes
Nr	Norriston gravelly sandy loam
Oc	Owen Creek sandy loam
On	Owen Creek-Norriston association
PaF	Parkview very stony loam, 20 to 35 percent slopes
PeE	Peeler sandy loam, 5 to 25 percent slopes
PeF	Peeler sandy loam, 25 to 40 percent slopes
Ph	Perceton-Hyannis association
Pr	Pinkham-Rock outcrop association
Ra	Randman sandy loam
RhD	Rawah loam, 3 to 10 percent slopes
Rk	Rock land
Ro	Rock outcrop
RtE	Rogert gravelly sandy loam, 10 to 25 percent slopes
Sp	Spicerton sandy loam
St	Stumpp clay loam
SuE	Sudduth loam, 5 to 15 percent slopes
Te	Tealson-Rock land association
Tn	Tine sandy loam
ToF	Troutville sandy loam, 15 to 45 percent slopes
Tv	Troutville-Newcomb association
Wa	Walden sandy loam
Wc	Wichup loam
YoF	Yochum gravelly sandy loam, 35 to 65 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (78)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; WD)

PITS

- Gravel pit (G.P.)
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end

Canals or ditches

- Double-line (label) (CANAL)
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; WD)
- Intermittent (int; I)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (SvE 107)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) (S)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot (0)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 1
JACKSON COUNTY AREA, COLORADO
(PEARL QUADRANGLE)

CARBON COUNTY WYOMING

R. 82 W. | R. 81 W.

T. 11 N.
T. 11 N.

T. 12 N.
T. 11 N.

T. 11 N.
T. 10 N.

(Joins sheet 2)

(Joins sheet 5)

R. 82 W. | R. 81 W.

LIMIT OF SOIL SURVEY

Scale 1:24000

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

This soil survey was completed in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of the Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10 000-foot grid based on state coordinate system.

CARBON COUNTY — R 81 W. | R 80 W. — WYOMING

T 12 N
T 11 N

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 6)

R 81 W. | R 80 W

Scale 1:24000

JACKSON COUNTY AREA, COLORADO NO. 2

Scale 1:24000

1/2 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 197[illegible] aerial photography by the [illegible] Department of the Interior, Geological Survey. Planimetric detail obtained from [illegible] minute series maps. 10 000-foot grid based on state coordinate system.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of the Interior, Geological Survey. Planimetric detail obtained from ... 10,000 foot grid based on state coordinate system.

Scale 1:24000

1 Mile, 0, 1, 2 Miles
5000, 4000, 3000, 2000, 1000, 0, 5000, 10000 Feet

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10 000-foot grid based on state coordinate system.

(Joins sheet 2) R. 81 W. | R. 80 W.

(Joins sheet 5)

(Joins sheet 7)

T. 10 N.
T. 9 N.

(Joins sheet 11) R. 81 W. | R. 80 W.

106° 30' 00"

40° 45' 00"

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10 000-foot grid based on state coordinate system.

R. 80 W. | R. 79 W. (Joins sheet 3)

(Joins sheet 6)

(Joins sheet 8)

T. 10 N.
T. 9 N.

R. 80 W. | R. 79 W. (Joins sheet 12)

0 ½ 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

[illegible] Department of Agriculture
[illegible] 10,000-foot grid based on [illegible]

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ⅝ ¼ ⅛ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10 000 Feet
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps 10 000-foot grid based on state coordinate system

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 9
JACKSON COUNTY AREA, COLORADO
(SHIPMAN MOUNTAIN QUADRANGLE)

R. 78 W. | R. 77 W.

106° 00' 00"

(Joins sheet 8)

T 10 N
T 9 N

R. 78 W. | R. 77 W.

(Joins sheet 14)

T 10 N
T 9 N

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1	¾	½	¼	0		1		2 Miles
5000	4000	3000	2000	1000	0	5000		10000 Feet

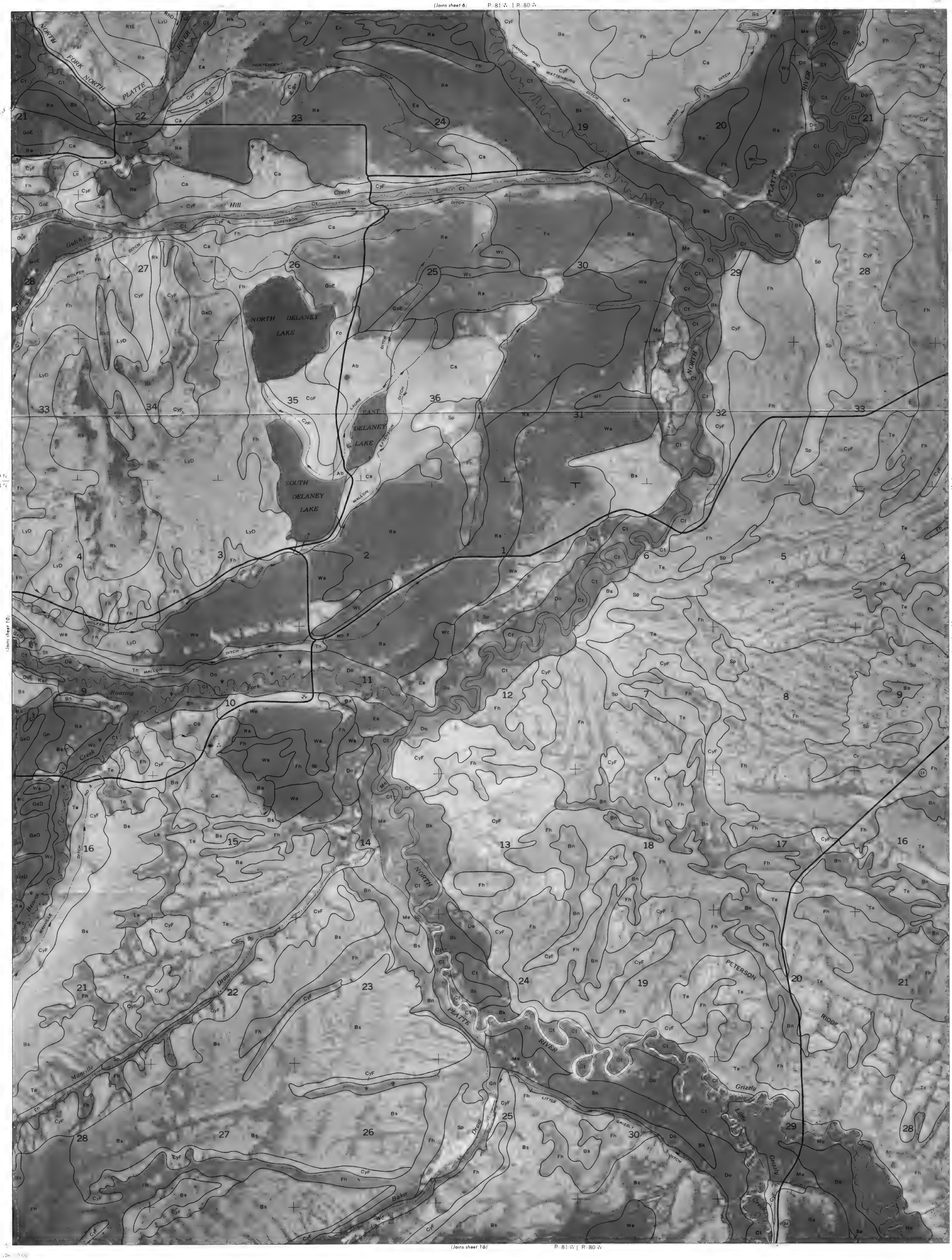
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10 000-foot grid based on state coordinate system.

Scale 1:24 000
1 Mile ... 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from ... aerial photographs by the ... Department of the Interior, Geological Survey. ... data obtained from ... 0,000 foot grid ...

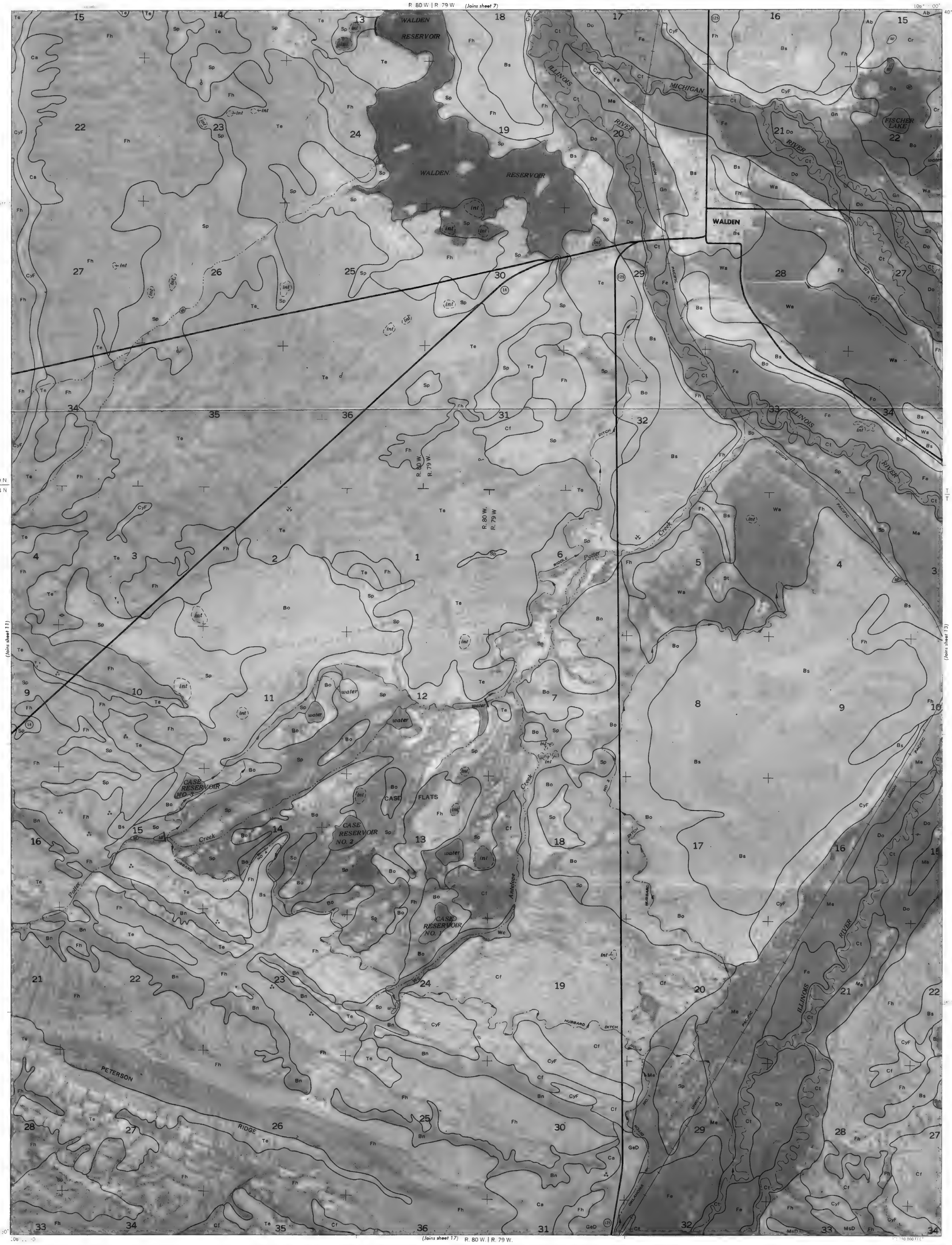


Scale 1:24000

1 ½ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet

[illegible] soil survey was compiled in 19[illegible]8 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 19[illegible] aerial photography by the [illegible] Department of the Interior, Geological Survey. Planimetric detail obtained from [illegible] 10,000 foot grid based on [illegible] state coordinate [illegible]



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1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U S Department of The Interior, Geological Survey Planimetric detail obtained from 7½ minute series maps 10 000-foot grid based on state coordinate system

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5000 4000 3000 2000 1000 0 5000 10000 Feet
0 1 2 Miles
Scale 1:24000

Orthophotobase compiled from 19 ?? aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series map. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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Scale 1:24000

1 ½ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

JACKSON COUNTY AREA, COLORADO

(TEAL LAKE QUADRANGLE)

(Joins sheet 10)

R. 82 W. | R. 81 W

T. 8 N
T. 7 N

T. 7 N
T. 6 N

(Joins sheet 16)

(Joins sheet 21)

R. 82 W. | R. 81 W

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior Geological Survey
Planimetric detail obtained from 7½ minute series maps
10,000-foot grid based on state coordinate system

JACKSON COUNTY AREA, COLORADO NO. 15

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 16
JACKSON COUNTY AREA, COLORADO
(COALMONT QUADRANGLE)

(Joins sheet 11)

R. 81 W. | R. 80 W

T. 8 N.
T. 7 N.

(Joins sheet 15)

(Joins sheet 17)

T. 7 N.
T. 6 N.

(Joins sheet 22)

R. 81 W. | R. 80 W

This soil survey was compiled in 1978 by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ⅝ ⅓ ⅛ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U. S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½-minute series maps. 10 000 foot grid based on state coordinate system.

JACKSON COUNTY AREA, COLORADO NO. 16

(Joins sheet 12) R. 80 W. | R. 79 W.

(Joins sheet 23) R. 80 W. | R. 79 W.

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

[illegible] was compiled in 1978 by the [illegible] Department of Agriculture, Soil Conservation Service and cooperating agencies.

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1 ⅝ ½ ⅜ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior Geological Survey
Planimetric detail obtained from 7½ minute series maps
10,000-foot grid based on state coordinate system

R. 78 W. | R. 77 W.

(Joins sheet 14)

T 8 N
T 7 N

(Joins sheet 18)

(Joins sheet 20)

T 7 N
T 6 N

(Joins sheet 25)

R. 78 W. | R. 77 W.

LIMIT OF SOIL SURVEY

LIMIT OF SOIL SURVEY

1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

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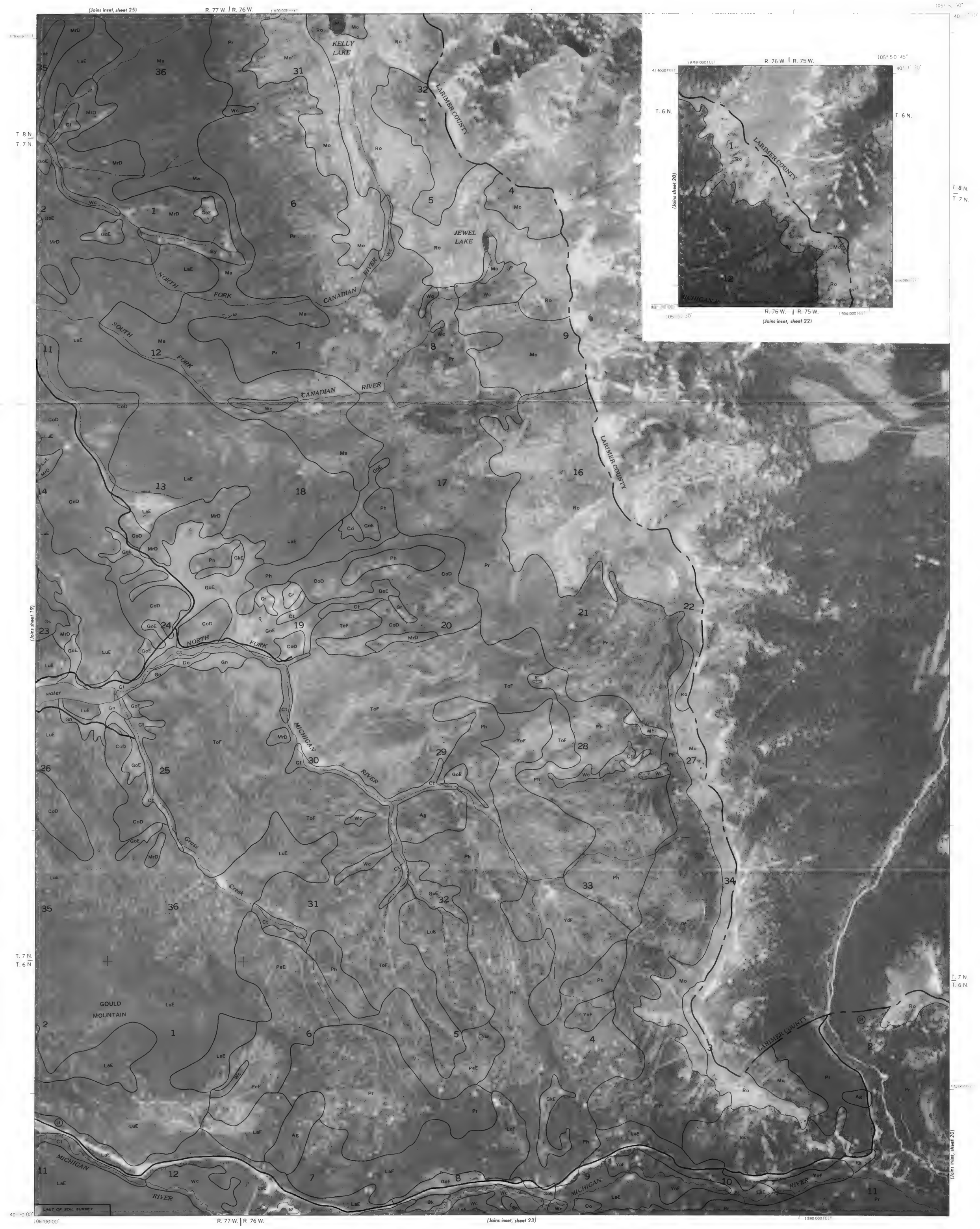

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1 ⅝ ½ ⅛ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

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Planimetric detail obtained from 7½ minute series maps
10,000-foot grid based on state coordinate system

R. 82 W. | R. 81 W.

(Joins sheet 15)

T. 6 N.
T. 5 N.

McGOWAN RESERVOIR
Middle Fork Mexican Creek
MEXICAN RIDGE
CLOVERLEAF VALLEY
Doran Creek
Colorado Creek
Wilset Creek
Fancher Creek
Grizzly Creek
LIMIT OF SOIL SURVEY
GRAND COUNTY

(Joins sheet 22)

(Joins inset, sheet 24)

Scale 1:24000

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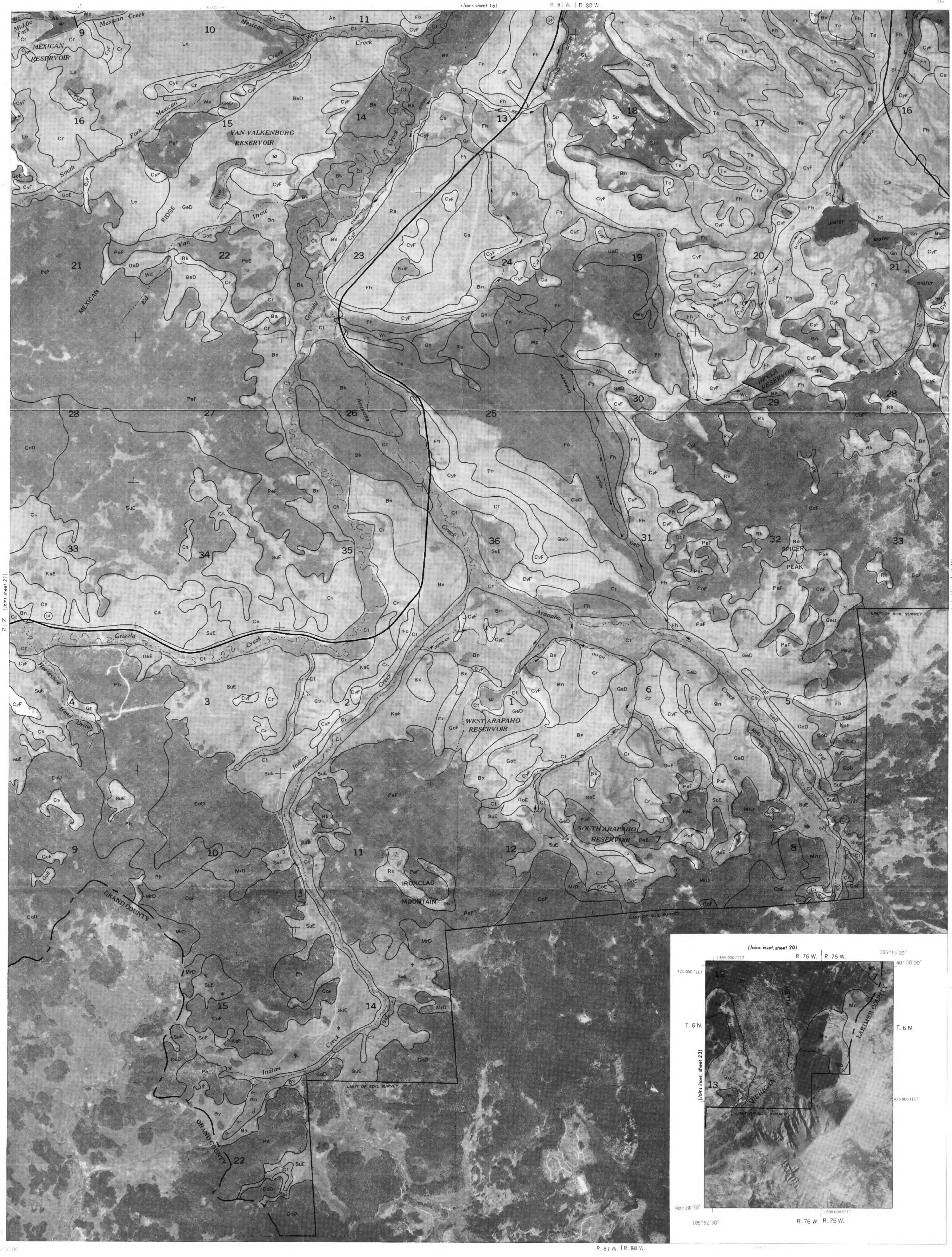

Scale 1:24000

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

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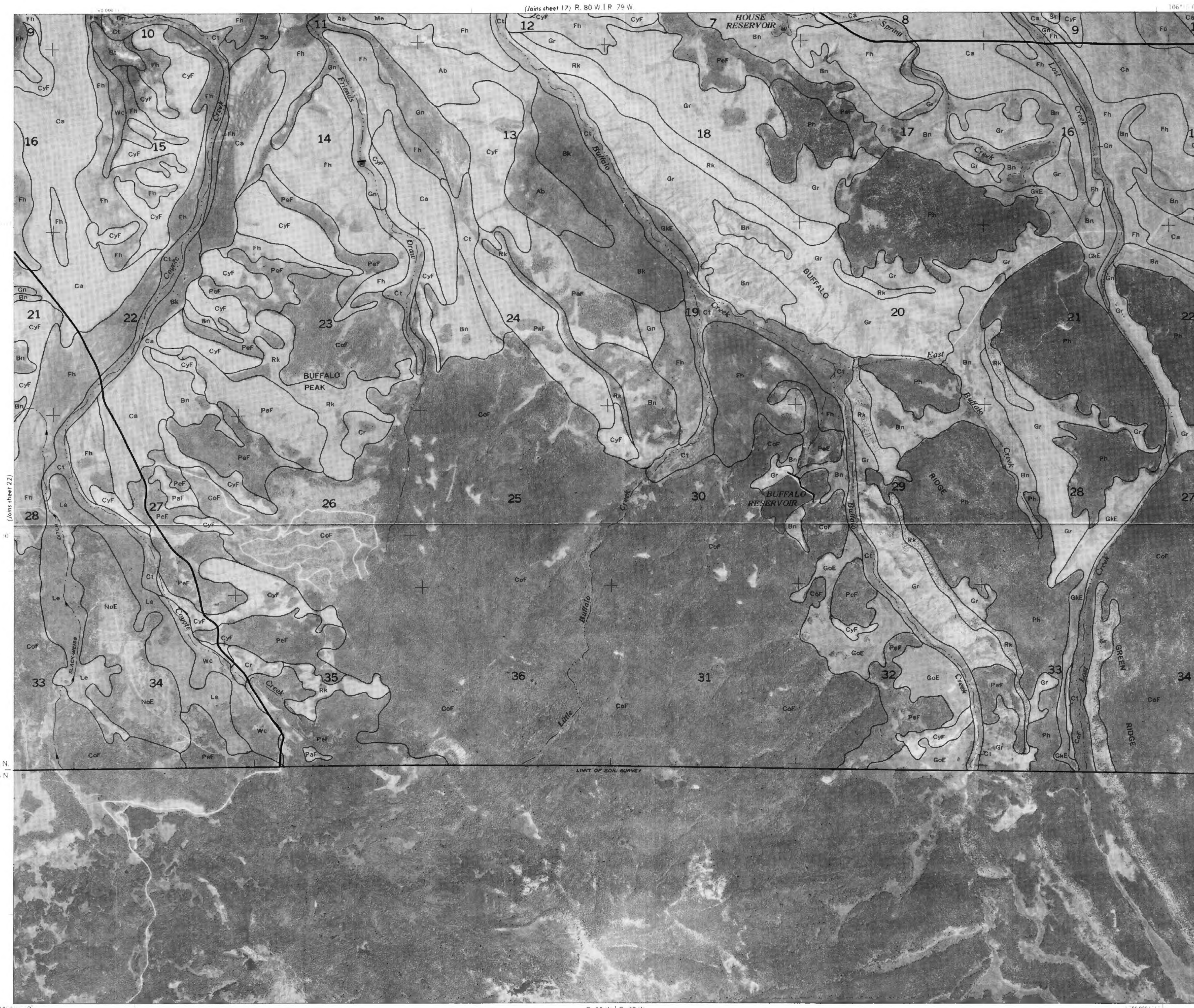

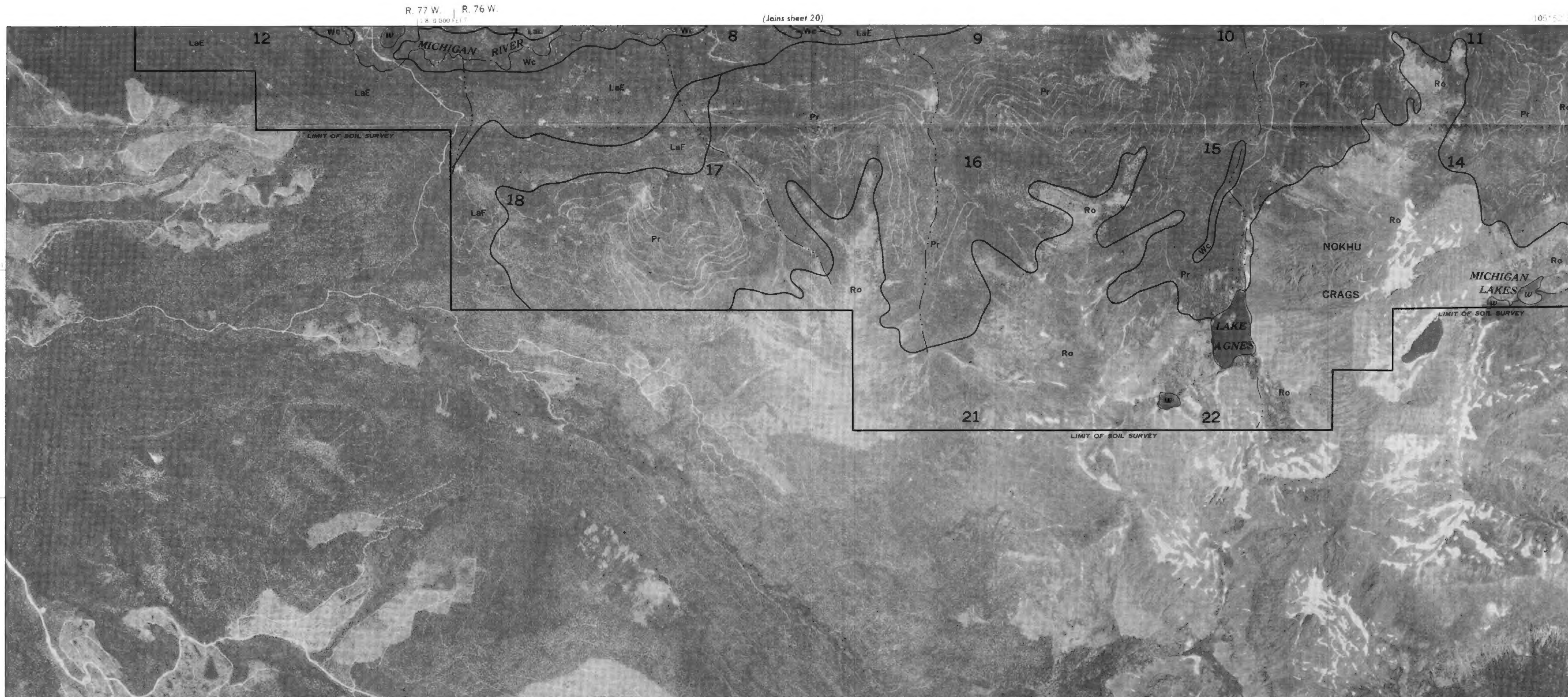

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Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10 000 Feet

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

(Joins sheet 18)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 21)

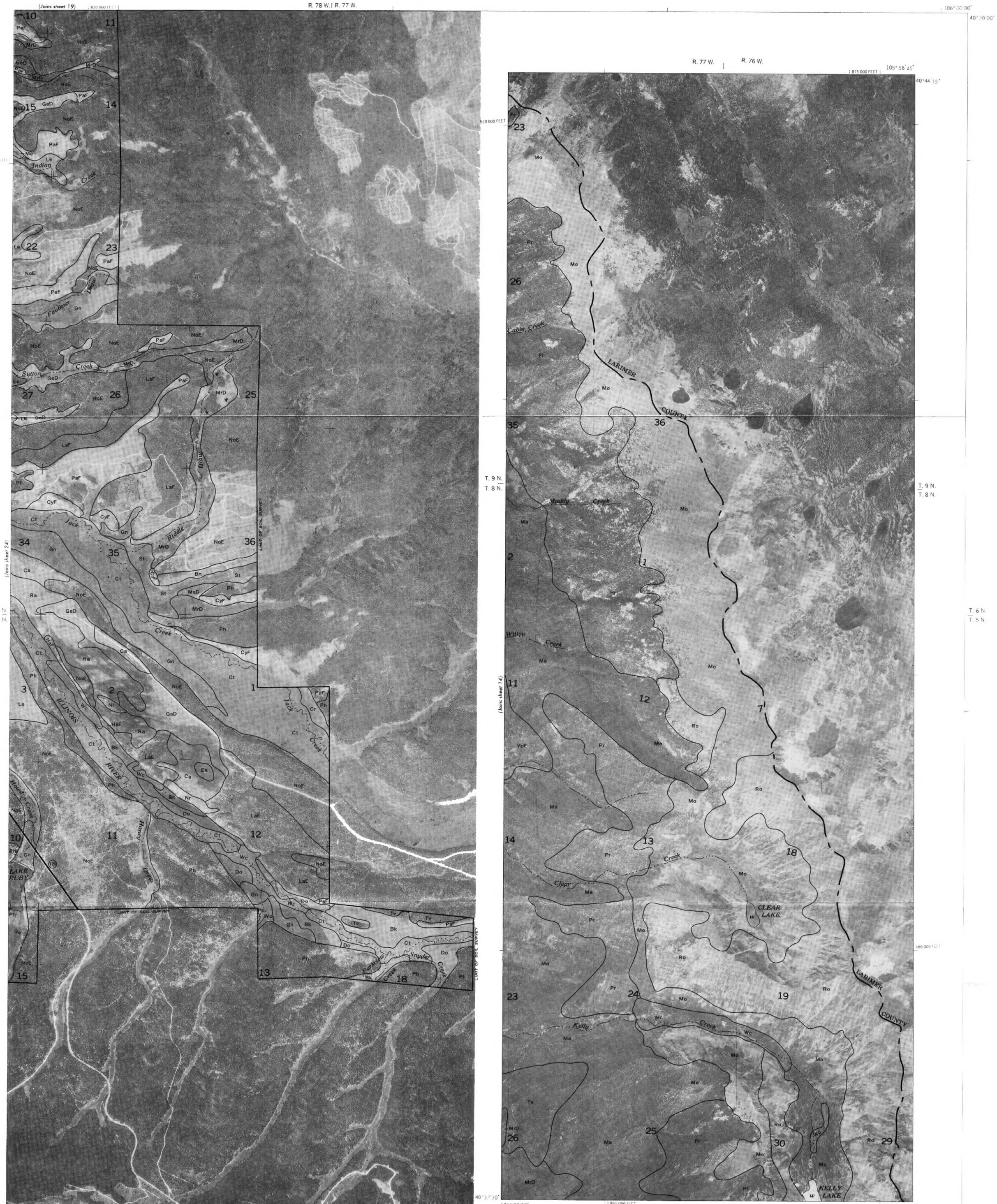
R. 79 W. | R. 78 W.
R. 82 W. | R. 81 W.
T. 6 N.
T. 5 N.
106° 15' 00"
106° 07' 30"
106° 31' 30"
106° 33' 30"
40° 30' 00"
40° 22' 30"
40° 21' 30"
1 800 000 FEET
1 820 000 FEET
1 706 000 FEET
1 714 000 FEET
400 000 FEET
380 000 FEET
375 000 FEET

Rand
Indian Creek
Sutton Creek
Faulkner Creek
ILLINOIS RIVER
Willow Creek
McKinnon Creek
Rock Creek
Jack Creek
Draw
Shearer Creek
Spring Creek
Badger Branch
East Creek
Hourd Creek
LAKE RUBY
SALEM DITCH
CHIEF DITCH
LIMIT OF SOIL SURVEY
GRAND COUNTY

This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

1 ½ ½ ½ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1976 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system



This soil survey was compiled in 1978 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

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